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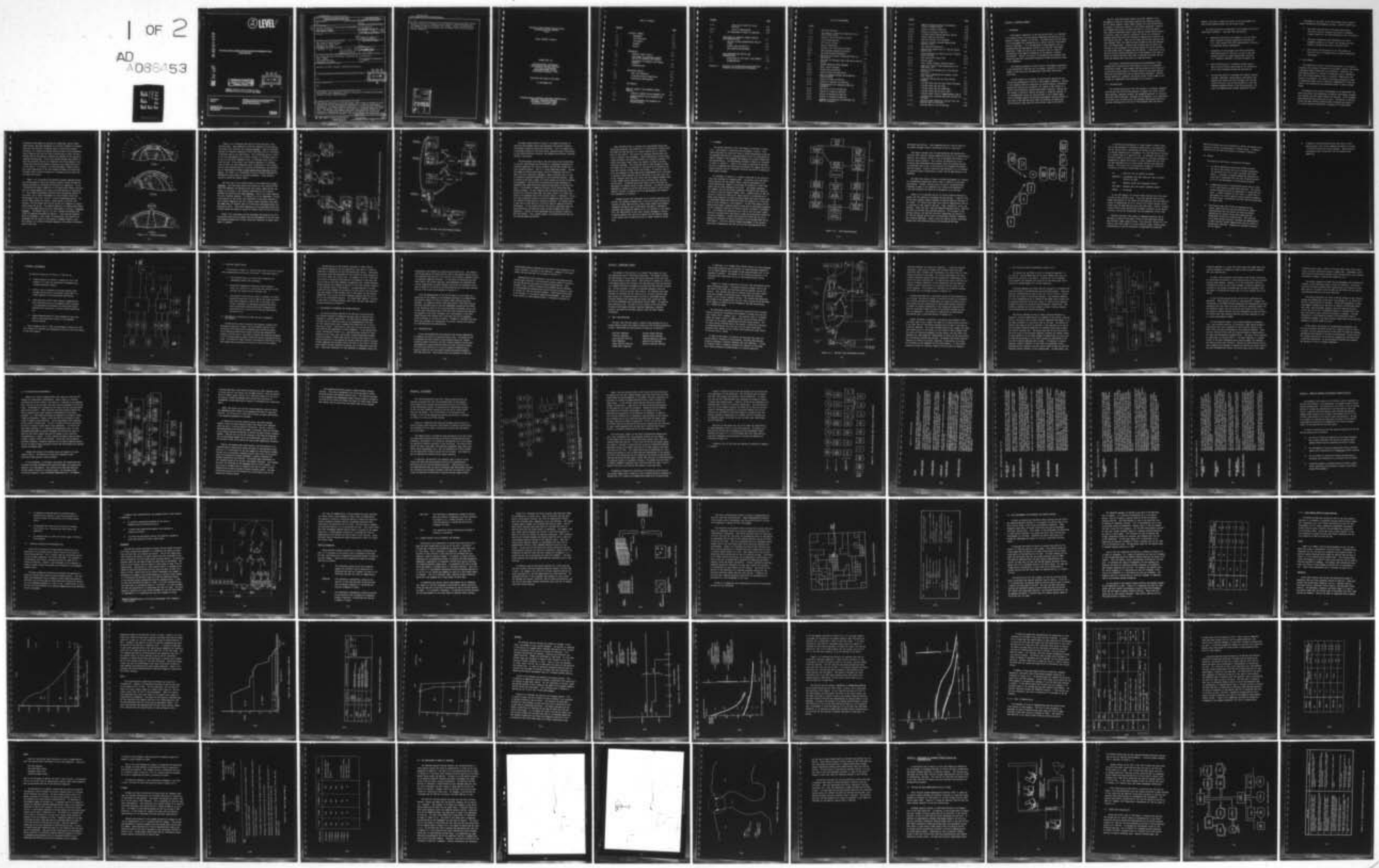

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Final Report
Phase A

Intelligence Preparation of the Battlefield (IPB) — An Automated Approach to Terrain and Mobility Corridor Analysis

Prepared For The
Battlefield Systems Integration Directorate
USA DARCOM

IBM

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Intelligence Preparation of the Battlefield (IPB) concept is attempt to significantly improve the processing and presentation of tactical intelligence information. It demands extensive preparation of terrain analysis information merged with weather and viewed in the context of a changing operational situation. The Tactical Intelligence Application Experimentation (TIAX) is an experiment to demonstrate the feasibility of automating that process and defining the required IPB products. The report presents the methodology used (over)

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in TIAX, operational concepts for an automated IPB process and IPB products. Specific concepts for automated terrain overlays, their development and development of mobility corridors are included. Finally the TIAX results and recommendations are presented, with a detailed list of data base and display categories.

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TACTICAL INTELLIGENCE APPLICATIONS EXPERIMENTATION REPORT (TIAX)

FINAL REPORT, PHASE A

SUBMITTED TO:

HEADQUARTERS USADARCOM
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SECTION 1. EXECUTIVE SUMMARY

1.1 BACKGROUND

"Intelligence Preparation of the Battlefield (IPB) is a comprehensive procedure which involves maximum integration and analysis of all aspects of enemy, weather, and terrain. Included within the IPB effort is the development and standardization of manual tactical intelligence analysis techniques. It is accomplished by using graphics such as annotated maps and photographs, overlays, and tactical intelligence templating. These are used as aids to analysis and as a means of disseminating intelligence information to the generals, colonels, and captains. IBP will also assist in determining the automatic data processing data base requirements necessary to meet the decision needs of the commander."

This opening paragraph of Draft TC30-27, Intelligence Preparation of the Battlefield, describes the IPB concept, currently in its early stages of definition and implementation within Army intelligence activities.

The IPB concept is an attempt to significantly improve the processing and presentation of tactical intelligence information. However, it also demands extensive preparation of terrain analysis information merged with variants due to weather, all viewed in the context of a specific and continually changing operational situation. Whereas the IPB concept is certainly logical and useful, a practical approach to its implementation across all Army missions is still being sought. Initial estimates against preliminary requirements indicate efforts in the range of 500-1000 man years would be necessary to develop the terrain analysis data alone for only critical areas of the world.

The U.S. Army Intelligence Center and School (USAICS) in its development of tactical intelligence doctrine has recently produced the All Source Analysis Center (ASAC) concept utilizing IPB processes. The manner in which this concept of intelligence operations interacts with command and control and other functions in a division and/or corps Tactical Operations Center (TOC) requires further definitization. In addition, there are several contractual efforts to be funded or expanded during 1979 which will eventually require use of portions of IPB products and data. These are the Corps and Division Tactical Operating Systems (TOS), the USAICS Tactical Automation Test Bed Architecture, and Project BETA. Internal Army decisions must be taken soon relative to the development of extensive amounts of terrain, weather, and intelligence data to support the IPB concept. A key factor in the decision on the ultimate affordability of the program is the level of detail of terrain and other data that is required to develop IPB products and support their use across all Army activities.

The Tactical Intelligence Applications Experimentation (TIAX) Program aims at definition of IPB products for use in an automated battlefield system. These products and the process in which they will be used must be described in sufficient detail so that data requirements and associated costs may be realistically evaluated. Specific program objectives, approach, and results of the initial phase of the program are summarized in the remainder of this section.

1.2 TIAX OBJECTIVES

The ultimate objective of the TIAX Program is to develop automated applications that utilize IPB processes to support all source intelligence analysts, maneuver analysts, and targeting analysts in a division and corps battle situation. Although the IPB emphasis is on preparation activities prior to hostilities, the automated applications must also consider continuation of the use of IPB processes after the battle

begins, since that is where the results of the considerable pre-hostilities planning effort will be of most value.

The applications must be developed in the context of realistic operational situations. They must take into account:

- Operational battlefield environments in the mid 1980's under currently projected organization and doctrine (i.e., ASAC concept, DTOC/CTOC organizational structures and projected systems complements)

- Interaction of IPB processes with other battlefield intelligence analysis functions, as well as how IPB-produced results can support operational functions, e.g., targeting, maneuver, artillery placement, etc.

- Basic simplification of voluminous terrain data to focus on the military significance of the information, and to allow automated storage and manipulation.

- The form and content of automated IPB products (graphic overlays, templates, report outputs, data bases) that provides the analyst and decision maker with the most useful end result, and yet are designed in a way that produces reasonable loads on the data processing, display, and communications systems supporting the TOC.

Achievement of the goals of the TIAX Program offers progress toward implementing IPB throughout the Army. Typical benefits are:

- Functional descriptions of IPB system applications that can be used to influence the design of automated systems planned for the CTOC/DTOC/ASAC mid 80's environment.

- Definitive topographic data requirements for use in automated systems, plus insight into the most efficient methods of producing the data in digitized form.

- More specific definitization of all IPB products as they will exist in automated form to support operational requirements.

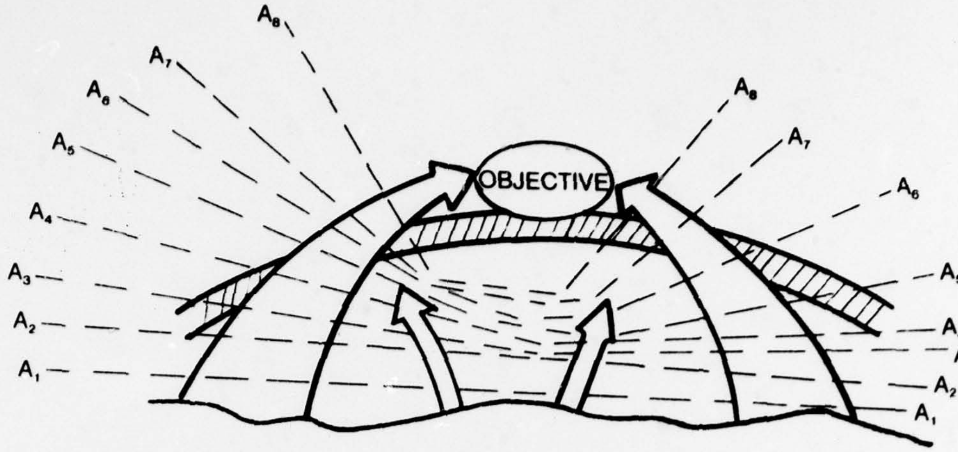
1.3 TIAX CONCEPT

The objective of tactical intelligence analysis is to organize, integrate, and interpret information on the enemy, terrain, and weather to determine enemy capabilities and intentions. Currently, the intelligence analyst is involved in assembling bits of information much like putting together pieces in a puzzle. Where pieces are missing, he estimates. The overall intelligence estimate is based on assembling as many facts as possible, judgementally filling the "holes," and interpreting the completed picture in terms of enemy intent.

The advent of IPB and the TIAX approach to its operational use offers the analyst the opportunity to develop intelligence estimates more rapidly, and with higher degrees of certainty. It also demands more preparation and planning on his part. The premise is that the analyst can more readily recognize enemy situations and intent if (1) he has carefully planned out in advance all of the options

available to the enemy for pursuing his objectives, and (2) these enemy options have been documented in the form of graphics to compare with real-time graphics (situation maps) as hostilities proceed. Obviously, it is easier to compare stored pictures of the preplanned enemy situation with the real time situation map to select one that matches than to continuously interpret the meaning of the constantly changing situation map. So the TIAX concept employs IPB products in real time situation analysis to determine with a high degree of confidence which option the enemy is pursuing, and at what point he is in that option. In addition, the TIAX operational concept affords more rapid compilation of the intelligence estimate--the prediction of enemy intent in terms of where he is expected to be at what time with what size forces.

Figure 1.3-1 illustrates the analytical process employed during the planning phase in which the analyst carefully thinks through the options available to the enemy for achieving his objectives. In the illustration the enemy's objective is to destroy two friendly divisions that are arrayed against him, and he has three options for achieving it: (A) a double envelopment operation with diversionary attacks in the center; (B) a single envelopment in which friendly forces are pinned against the river; and (C) a classic breakthrough attack. For each of these options the analyst, using results of previous IPB analyses, fits the enemy force to the terrain at a sequence of logical points along the option. The graphic depiction in situation map format of all of the enemy forces at one of these points is called a "Situation Snapshot". The dashed lines A1, A2, etc., through A8 represent the series of snapshots developed for Option A. The situation snapshots would be developed in like manner for each option, and stored in an automated file for recall by the analyst if needed; however, their main purpose is to develop situation templates, the primary IPB product used in real time.



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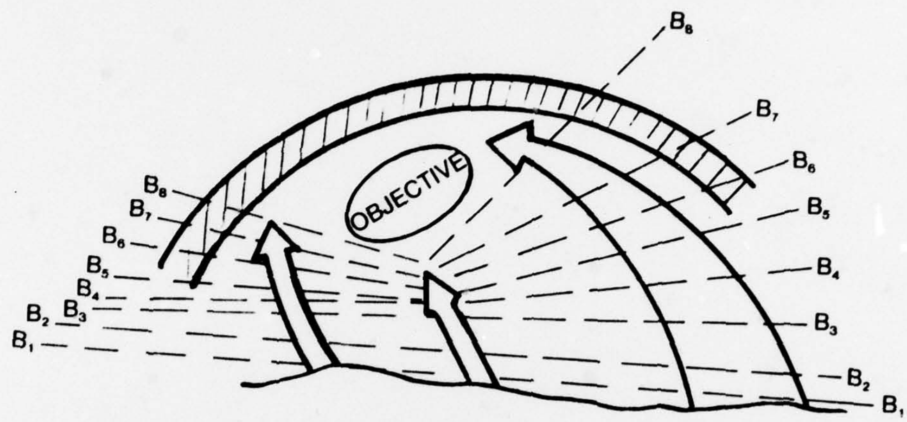

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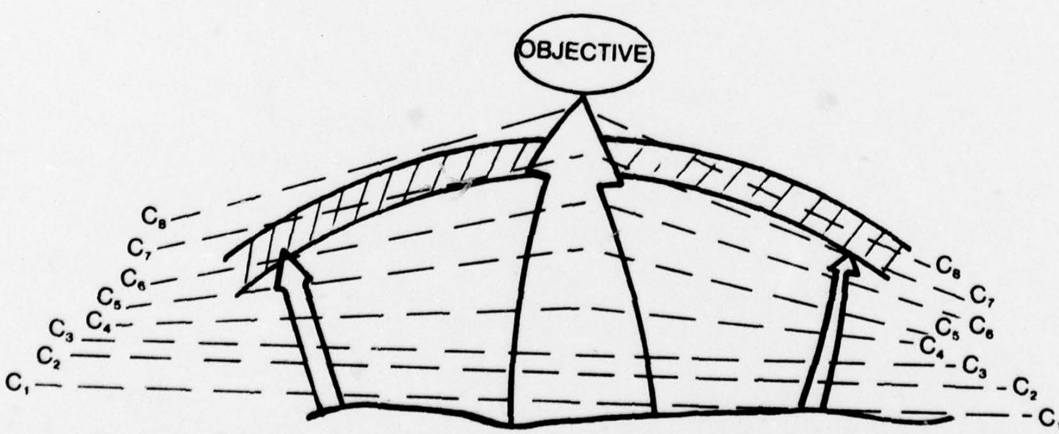

OPTION C

Figure 1.3-1. Situation Snapshots

Figure 1.3-2 illustrates the results of the next step in the planning phase. Upon completing situation snapshots for each option, the analyst next develops the situation template. These are selected portions of situation snapshots in which the enemy force is configured differently than in any other option. The differences may be a result of the unit deployments due to terrain factors, or different types of units in a particular geographic area, or different sized units in a specific area. In any event, the situation template is a configuration of units on a map background which if detected in that arrangement at that location would be an option differentiator, and therefore key to identifying the enemy in that option and at that point in the option. As Figure 1.3-2 illustrates, sets of situation templates are developed for each option by analyzing snapshots. These would be digitally stored for analyst recall.

The final step in the planning phase is the preparation of event templates. Once the enemy options are planned out and situation snapshots and templates are defined within each option, enemy actions subsequent to the point in the sequence represented by the situation template are compiled into event templates. There is an event template for each situation template. It consists of (1) an alphanumeric listing (event matrix) of the events that immediately follow those depicted in the situation templates; and (2) a graphic (event template) that shows the Named Areas of Interest (NAI's) in which the anticipated events are expected to occur. These event templates are also developed during the planning phase and digitally stored for analyst recall during the battle.

Figure 1.3-3 illustrates how the preplanned IPB products are utilized during hostilities to support the G2's development of the real time intelligence estimate and to focus collection resources on higher yield areas of interest.

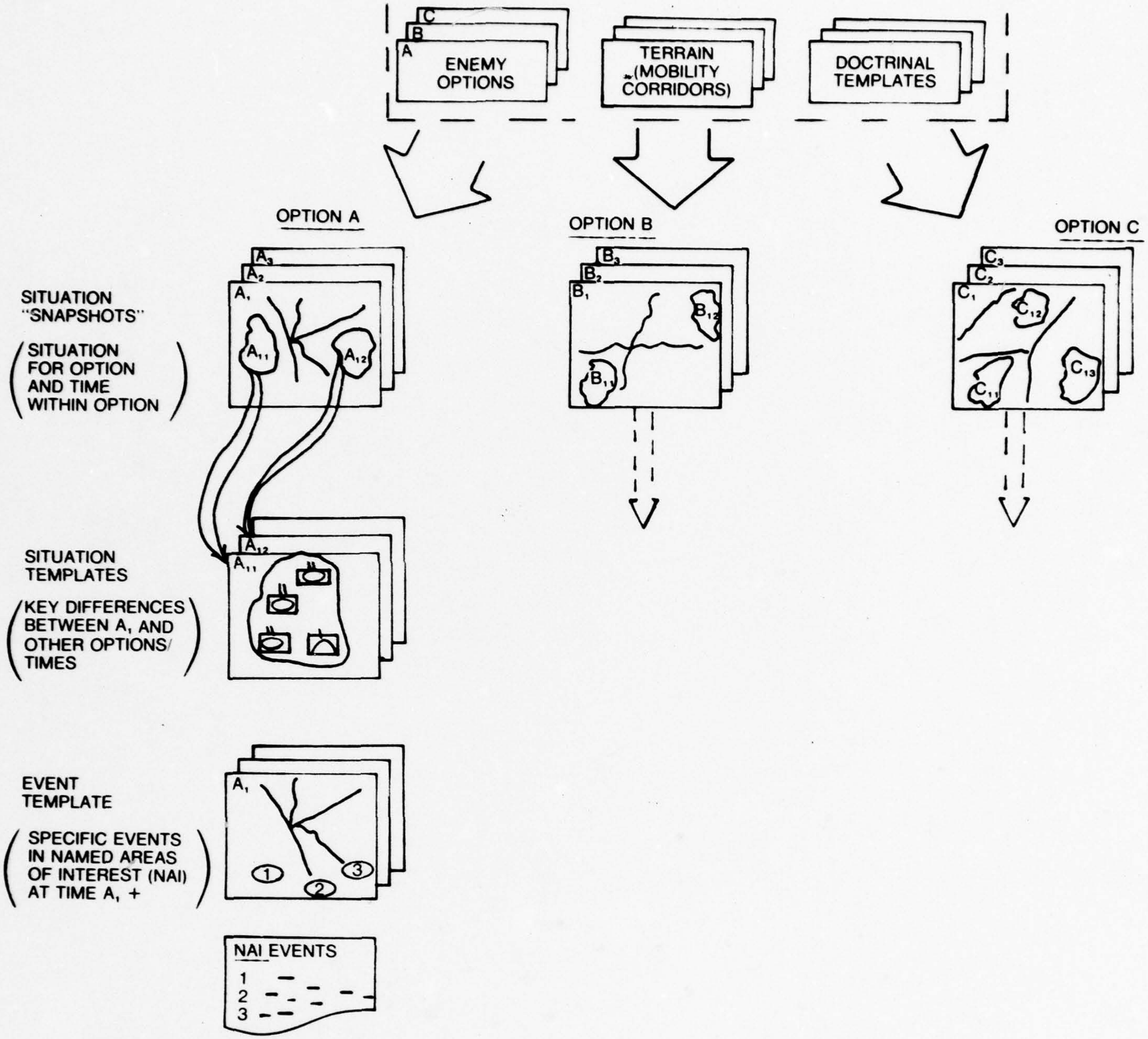

Figure 1.3-2. IPB Products to Determine Enemy Options and Point Within Option

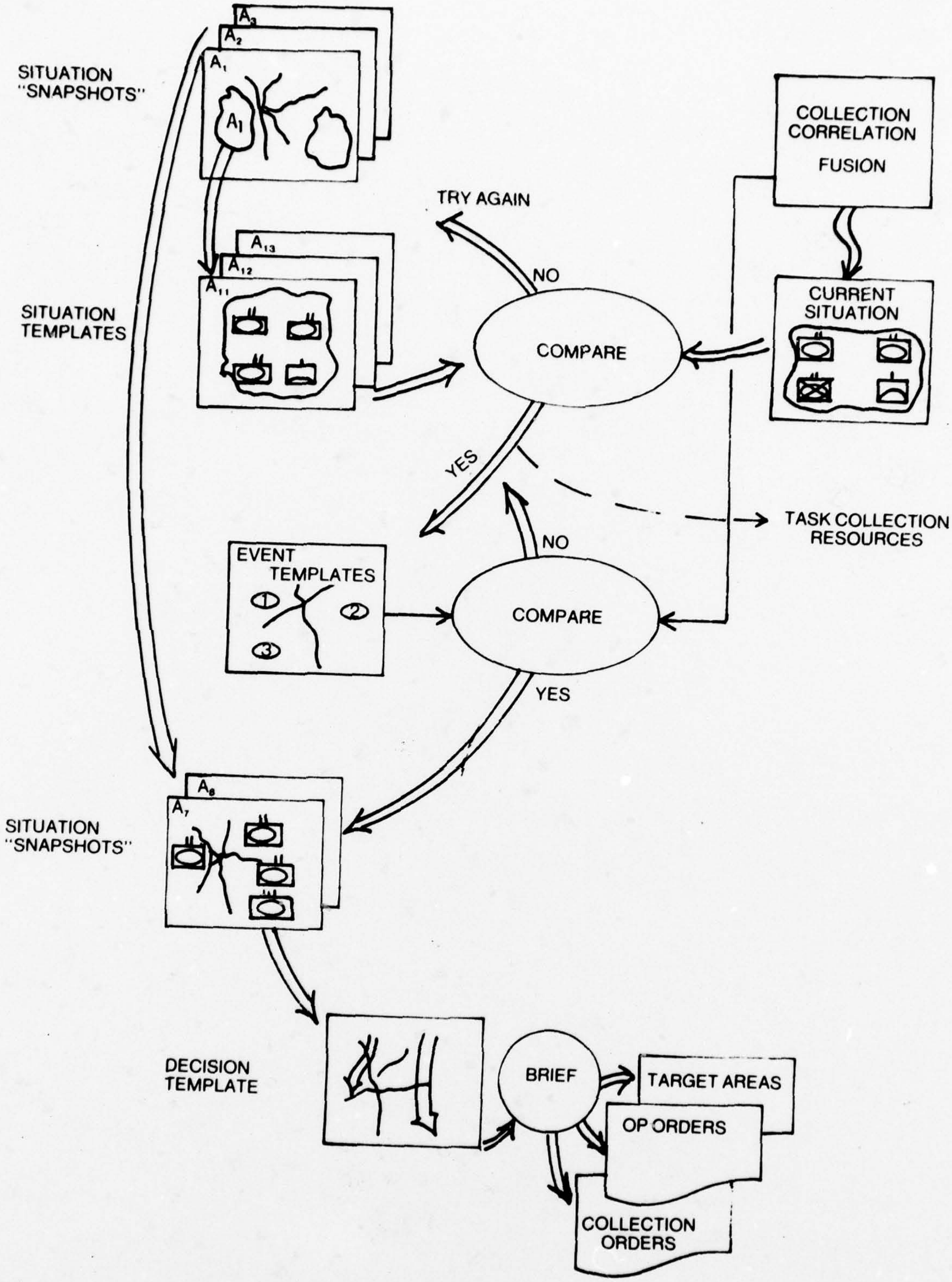

Figure 1.3-3. IPB Real Time Intelligence Estimate

The upper right portion of Figure 1.3-3 shows the process of receiving intelligence inputs and developing the current situation map through correlation and fusion processes. This is assumed to be a continuous process of receiving inputs, assessing their significance to the current military situation, and updating the military situation display if warranted.

The IPB products are shown on the left side of the illustration. In the real time process the IPB analyst is constantly searching his situation templates file trying to match one with the current real time situation display. This is a visual comparison process. He does not expect to find an exact match, and will frequently draw on his other IPB files (doctrinal templates, terrain overlays, etc.) to try to rationalize observed differences in the situation displays. When he thinks he may have a match, his first actions are to try to confirm his hypothesis. He does this by accessing his event templates to determine what enemy activities should be observable in the next few hours, if the enemy is indeed at the point in his option that the analyst suspects. He next requests that collection resources place a priority on collecting data about the events cited in his event template in the sequence and at the locations (NAI's) indicated. He cues the input processing system to alert him immediately upon receipt of any returns to these specific collection requests. He further places a time limit on how long he is willing to wait to receive verifying information. If the system notifies him that no confirming data has been received by the specified time, he would probably drop that hypothesis. Several of these hypotheses may be working in paralled with one another. Thus, system support in eliminating those that are not verified would be helpful.

When confirming data is received that anticipated events have indeed been observed, the probability is significantly increased that the enemy has been detected in a certain option and at a specific point in that option. The analyst can therefore proceed more positively to exploit that knowledge. Toward developing a current intelligence estimate, the analyst references his situation snapshot file, selects one several hours hence, and updates it based on current situation knowledge. This forms the basis of the estimate of where the enemy will be if he continues in the option he is presently pursuing with terrain already taken into account. It would be used to brief the commander so that appropriate countermoves can be initiated. In addition, event templates can be exploited to not only focus colletion resources again but also notify the Fire Support Element (FSE) of what targets can be expected at which locations over the next several hours. Preplanned operations orders can be finalized for deployment of friendly forces to meet the enemy. The terrain analyses completed in advance by the G2 staff would be useful to the FSE and maneuver sections in planning artillery emplacements and friendly force movements to interdict.

Although certain IPB techniques can be usefully applied at any echelon, the concept presented here is felt to be most practical at echelons no lower than division, where larger enemy force elements (regiments and above) must be monitored, and where a reasonable automated data processing capability will be resident in the center. Also, the continuation of this basic process throughout a battle situation demands local ability to modify the IPB products stored in the system, and to develop new ones as enemy courses of action vary.

1.4 APPROACH

The overall approach to the TIAX Program is outlined in Figure 1.4-1. The program is structured into two phases, A and B. This report describes the results of Phase A, which concentrated on defineing automated IPB terrain oriented products after first developing an overall concept of how automated IPB products can be most effectively used operationally. The methodology followed in Phase A is discussed in detail in Section 2. Phase B will focus on specifically defining the use of automated IPB techniques and products to support the FSE in target planning, the G3 in maneuver planning, and the G2 in making his intelligence estimate.

As indicated in Figure 1.4-1, Phase A consisted of two series of tasks that conclude in a demonstration. One series, real time application analysis and IPB product needs, required development of an overall operational concept in which many IPB products in their automated form are used throughout the battle. The concept addresses, for example, how the IPB process generates information that would be of value to the Fire Support Element (FSE). Another result of the IPB process of carefully planning out enemy options is determination of enemy event sequences (including location data) that could provide sets of preplanned target data describing where the enemy will be with what type of units (targets) in what sequence. As the intelligence officer monitors the actual situation against these sets of preplanned sequences, he will eventually identify the specific option the enemy is implementing. This affords all operations units--FSE as well as others--opportunities to preplan their activities so they can be much more responsive to battle situations. Further definitization of what IPB can do to support all functions in battle situations will be accomplished during TIAX Phase B. This will require further development of the scenario data base to upgrade the test bed facility for experimentation with

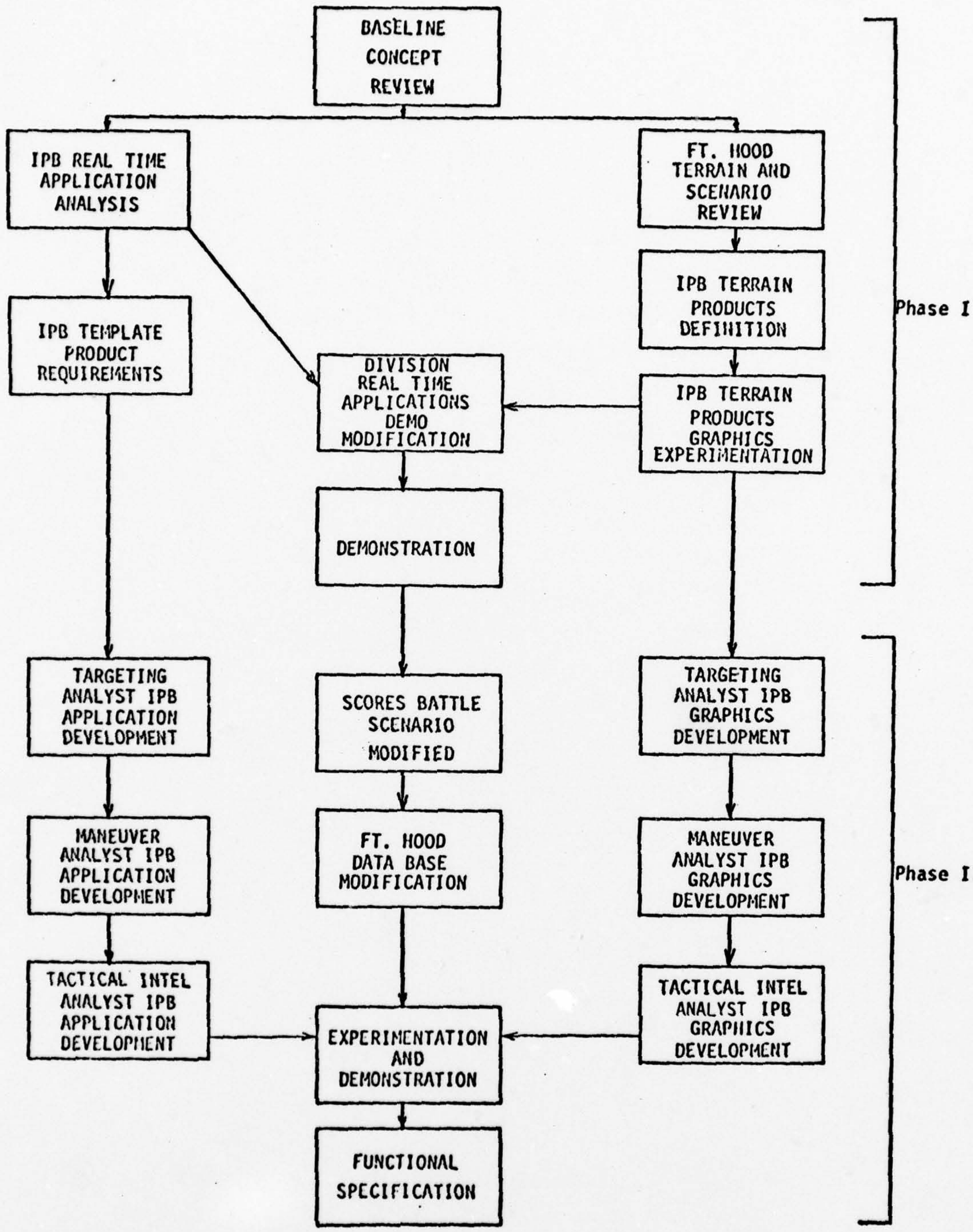

Figure 1.4-1. TIAX Program Approach

additional applications. These augmentations will also be based on the SCORES European scenario transferred to the Ft. Hood area.

Each phase concludes with an experimentation and demonstration period at IBM's Tactical Systems Demonstrating Facility in Gaithersburg, Maryland, that features "hands on" use of automated IPB products in a realistic battle scenario. This provides the opportunity to get reactions from experienced Army personnel about the proposed concept of operational use as well as the specifics of automated IPB product form and content. Finally, functional specifications will be produced at the end of Phase B describing in detail the IPB applications to be automated.

The other task series in Phase A required development of a concept for representing conventional terrain data in terms of its military significance. Further, the data had to be easily interpreted when presented to users in an automated color display and organized in a way that permitted the benefits of automation to be realized.

Figure 1.4-2 illustrates the set of terrain products required to support the TIAX concept of automated IPB applications. A general flow of how these products combine together to produce mobility corridors is also shown. All terrain data other than lines of communication (LOC's) is contained in four types of overlays: Slope, vegetation, soils, and wetlands. These plus LOC's form the combined obstacles matrix; mobility corridors are derived from combined obstacles. As discussed in the previous section, the mobility corridors incorporate the results of all terrain analyses and are basic to developing situation "snapshots" and situation templates. These in turn are used as primary interfaces between real time situation analysis and preplanned IPB data.

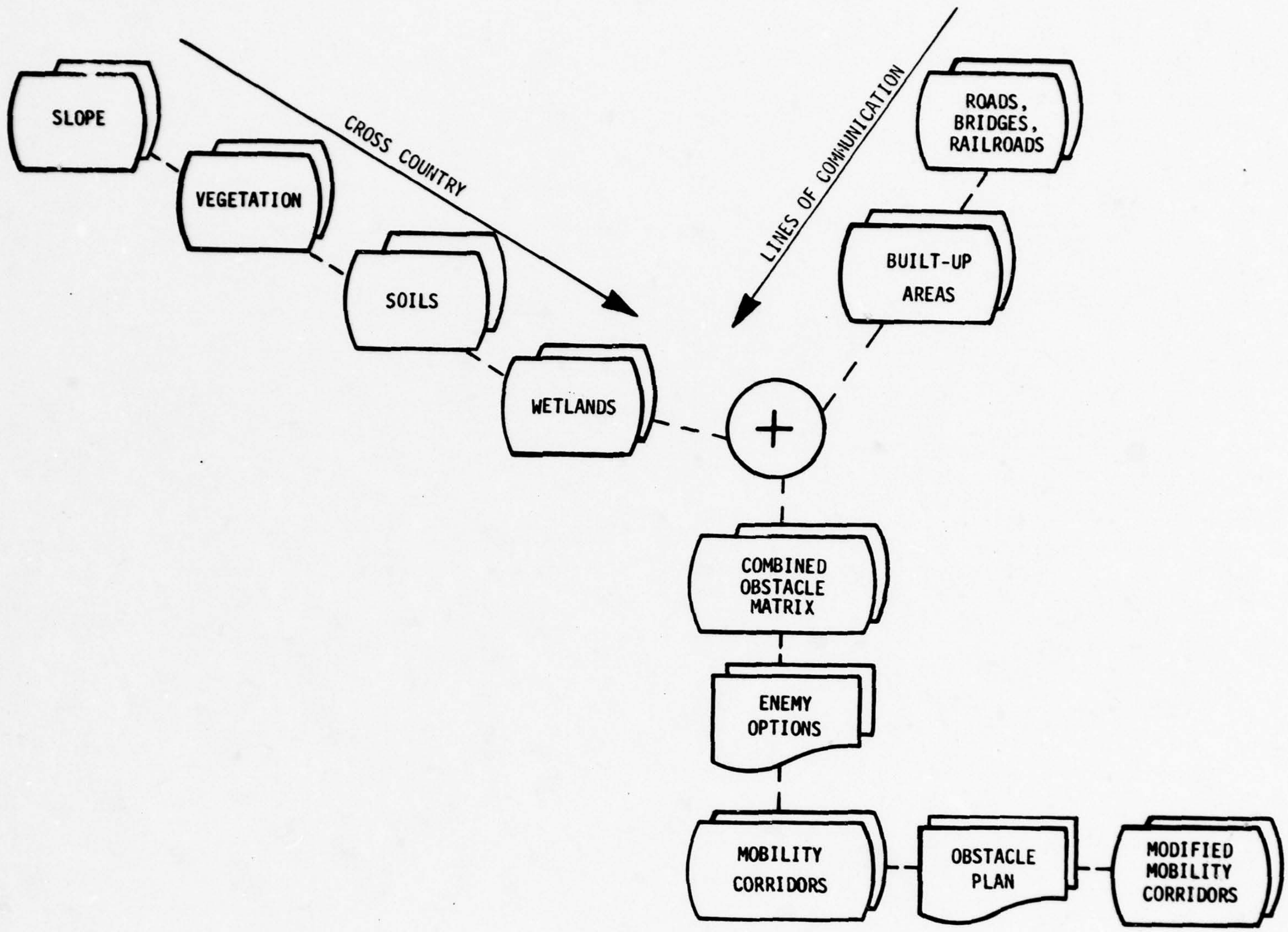

Figure 1.4-2. IPB Terrain Products

To simplify the presentation of large volumes of terrain data, and to take advantage of automation capabilities, a new approach to the way terrain data is represented on overlays has been developed. It involves developing the "throughput" of a selected piece of terrain for a ground force of a specified size. To interpret the effects of multiple elements of terrain on force mobility, and take advantage of automation to support the process, a single, common mobility scale has been developed for all terrain factor overlays and composites thereof. This scale and its relationship to mobility in terms of information of military significance is as follows:

GO	=	Doctrinal rate of advance or greater
INHIBITED	=	Considerably less than doctrinal rate of advance (from 50 to 100%)
SLOW	=	Movement slower than dismounted infantry
VERY SLOW	=	Movement only with unusual engineer support
STOPPED	=	No passage

In the TIAX concept, all terrain factor overlays are color-coded in terms of this mobility scale. Thus, each terrain factor can be viewed individually for its impact on force mobility, and the composite effects of combinations of twc or three or all terrain factors can be viewed using the same mobility scale and color codes. Further, variants of each terrain factor overlay due to season or weather can be handled similarly, and can be incorporated into the composites in real time.

Mobility corridors (the inverse of combined obstacles) can be evaluated in terms of how large a force can the enemy move through the corridor in what length of time. This resulting "rating" of a corridor is also color-coded in a 5-part mobility scale, allowing ready interpretation of the net evaluation of enemy mobility potential.

Mobility corridors can also be modified to reflect the effects of an obstacle or barrier plan developed by friendly forces. A complete explanation of this mobility concept is included in Section 5.

1.5 RESULTS

The results of TIAX Phase A included the following:

- An initial operational concept was defined allowing for use of IPB products not only in advance preparation for the battle but also in real time after the battle begins. A feasible, systematic method was developed for using IPB in consonance with real time situation analysis to aid in the development of intelligence estimates.

- A method was devised of interpreting terrain data in terms of its significance to ground forces mobility. The various terrain subfactor effects are expressed in a single mobility scale. A useful byproduct of this result is definition of requirements for terrain analysis data to support automated IPB applications (considerably less than that being developed for manual use).

- Real terrain data from ETL/TAC was converted to the single, common mobility scale and digitized for graphic experimentation with the effects of color and pattern combinations to display terrain data along with map backgrounds and military situation data. The resulting color coded overlays currently installed and demonstratable at IBM's Tactical Systems Demonstration Facility (TSDF) at Gaithersburg, Maryland. Examples are included in Section 7 of this report.

- A number of workshop demonstrations were held in which Army personnel from various commands and agencies involved in IPB participated and offered comments. Where feasible, improvements were incorporated into the demonstration capability.

SECTION 2. METHODOLOGY

The specific objectives of Phase A of TIAX are to:

- Conduct analyses to develop a concept for use of IPB products in a real time operational environment that includes automation support.

- Define a set of automated IPB terrain overlays that includes the militarily significant terrain data in a format amenable to ADP manipulation and display.

- Using realistic terrain data, develop a demonstration that illustrates the use of automated terrain overlays in an operational environment, and that allows experimentation with variations in terrain overlay design and use.

- Conduct demonstrations for Army personnel to gain reactions to the operational utility of the automated terrain overlays.

Phase A began on July 5, 1978, and concludes on October 20, 1978 This section will describe the methodology utilized in this first phase of the TIAX program.

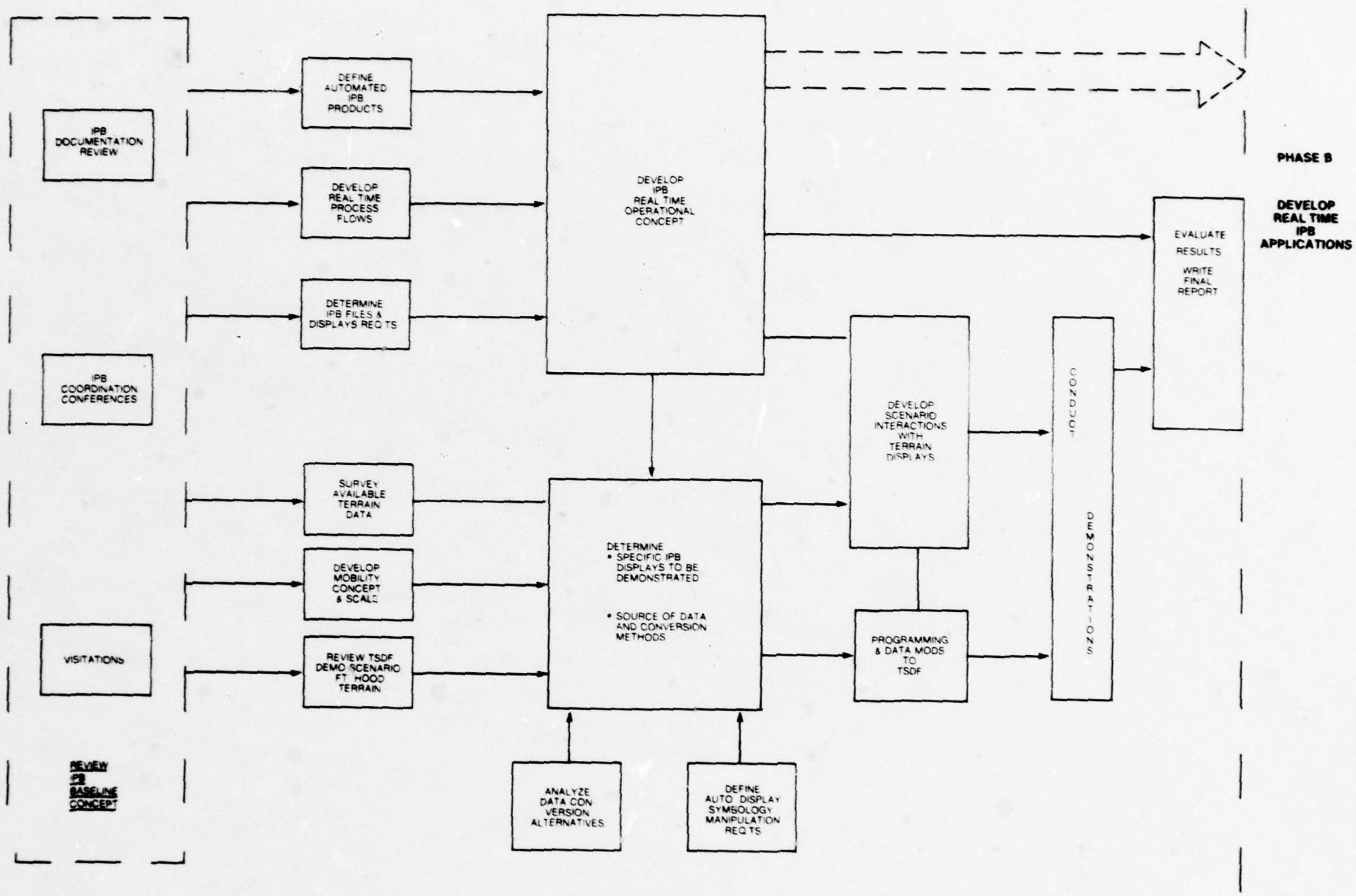

Figure 2-1. Phase A Methodology

2.1 BASELINE CONCEPT REVIEW

As indicated in Figure 2-1, Phase A began with a review of current Army documentation defining the IPB concept. Visits were made to:

1. 18th Airborne Corps, to discuss their experience in implementing manual IPB procedures;

2. Engineering Topographic Laboratory Terrain Analysis Center (Ft. Belvoir), to review how they perform terrain analyses and develop terrain overlays; and

3. Intelligence Threat Analysis Center of INSCOM, to discuss potential operational uses of some of the types of terrain data being produced by ETL/TAC for a particular area. Further, attendance at DARCOM/BSI sponsored IPB coordination conferences offered additional information and opportunities for discussion with various organizations involved in IPB.

2.2 DEVELOPMENT OF OPERATIONAL CONCEPT FOR USE OF AUTOMATED IPB PRODUCTS

Following this review of baseline IPB concepts, analyses were performed to describe in detail the IPB products required in an operational environment having automated data processing support, and to develop an operational concept defining how automated IPB products could be used in real time to support the functions performed in an All Source Analysis Center (ASAC) and Tactical Operations Center (TOC). The results of these analyses lead directly into Phase B of the TIAX Program and are presented in Sections 3 and 4 of this report.

The definitions of IPB products contained in draft TC30-27, Intelligence Preparation of the Battlefield, were used as a point of departure in developing the TIAX IPB operational concept. Information and process flows were developed for the creation of these products as well as for their use in real time. For example, one flow illustrates the process of developing IPB products with emphasis on the work that must be done by the local commands as opposed to the support agencies. Another process flow focuses on the use in real time situation analysis of the complete array of IPB products. No organizational or system constraints were imposed in the analysis at this point, with the result that many outputs of IPB analyses (and in some cases the IPB products themselves) are of value to the G-3 maneuver analysts and the FSE as well as the intelligence analysts. The operational concept is carried to the point of defining displays, data files, and hard copy reports/ messages necessary to support it.

2.3 DEVELOPMENT OF AUTOMATED IPB TERRAIN PRODUCTS

The terrain products defined in the IPB real time application were further analyzed to determine how they could be realistically displayed in tactical application. The IBM Tactical Systems Demonstration Facility (TSDF) was used as the experimentation test bed. The TSDF scenario data base is adapted from SCORES and set in the Ft. Hood area of Texas. The terrain in that area is quite open and flat, thus offering few impediments to force movements. It was decided that a more "interesting" terrain (i.e., one having more variety of slope, vegetation, soil type, etc.) would offer a more representative demonstration situation. Rather than create fictitious data (and risk it being unrealistic) it was decided to use the results of terrain analyses already completed and available within the Army in the form of 1:50,000 clear acetate overlays designed for manual use in conjunction with Army maps. These were converted to a form amenable to automated display and

manipulation (for details on conversion see Section 6.3). The categorization and scaling of terrain factors used in the manual overlay set was also modified (see Section 5) to allow for more effective computer support in developing composite overlays. In the course of designing the automated form of the terrain overlays, experimentation was conducted with various combinations of symbol patterns and colors to represent terrain data in terms of its effect on military mobility over the ground surface. Results of this work are discussed in Section 7.1.

With the determination of the terrain data to be utilized, and definition of the formats of the automated overlays to be demonstrated, the scenario context in which to present these overlays was next examined. An extensive scenario data base exists in the TSDF that was basically developed under a previous DARCOM/BSI program called DIVRAS. It was decided to build on this existing scenario backdrop, and so real terrain data from another part of the world was inserted into appropriate segments of the Texas landscape, and a continuation of the basic DIVRAS scenario was devised that illustrates the use of automated terrain overlays in a battle situation. A number of 1:50,000 scale segments were designed and implemented, from which a subset was selected for experimentation and demonstration.

2.4 EXPERIMENTATION

Initial experimentation was conducted with varicus combinations of patterns and colors to represent terrain data. The objective was to determine the most effective color/pattern design for showing differing grades of mobility for each terrain subfactor overlay when superimposed on a map background and/or military situation display. The result was selection of a 5-color scheme to represent the 5 grades of mobility with the pattern density decreasing gradually from STOP toward GO. The desired effect was achieved, in that the

color/pattern density combinations facilitate visual selection of the "open" corridors of advance by the operator. Examples of the color/pattern design selections are included in Section 7.1.

Demonstrations were conducted in which the color-coded terrain overlays were utilized in an operational scenario sketch to simulate how the IPB terrain data might be employed operationally. Army personnel from a variety of agencies and commands having interests in IPB attended the demonstrations during the period October 6, 1978 to October 20, 1978 and provided comments. Modifications were made to the displays to incorporate suggested improvements. More detail on the results of these demonstrations is included in Section 7.0.

SECTION 3. OPERATIONAL CONCEPT

The purpose of this section is to explain the concept for real time operational use of IPB-related techniques. The concept involves the functioning of one or more IPB analyst positions within the Corps All Source Analysis Center (ASAC). Each position is manned by a skilled intelligence analyst who interacts with the data base files and displays in a computer-assisted environment to perform the IPB functions assigned him. He has available a variety of prestored templates, maps and matrices for input to the real time process. He interacts with other functions in the ASAC and TOC, making use of military situation maps kept current by a situation analyst (similar to the DIVRAS concept situation analyst) and requesting new sensor data collections from the Mission Management and Dissemination Section (MMDS). He supplies other functions (e.g., FSE and G-3) with outputs of the IPB process including intelligence estimates (decision templates), combined obstacles and mobility corridors graphics data and other related information.

3.1 REAL TIME OPERATIONS

The real time TIAX-IPB system is based on the availability (in a storage medium suitable for graphic display) of the following categories of data. Definitions and descriptions of these are in Section 4.

Doctrinal Templates	Terrain Factor Overlays
Situation Templates	Weather Factor Overlays
Event Analysis Matrices	Combined Obstacles Overlays
Event Templates	Obstacle Plan Overlays
Target Analysis Matrices	Mobility Corridor Overlays
Target Event Templates	

In addition, it is assumed that friendly forces will have knowledge about enemy objectives and his options for achieving these objectives. All the above elements are assumed to have been developed prior to the outbreak of conflict. The purpose of the following discussion is to highlight their operational use by an intelligence analyst during conflict.

Figure 3.1-1 gives an overview of the real time IPB-related intelligence estimating concept. The boxes enclosed in dashed lines at the top right of the figure are functions occurring external to the IPB process. They indicate the flow of incoming sensor and other intelligence data through a correlation-fusion center and the resultant updates to the current situation display. This display and processing are assumed to be automated with the real time situation being developed using elements of USAICS Tactical Automation Test Bed Architecture, e.g., TEMPRO and LAMAS.

The IPB analyst regularly examines the current military situation display looking for new patterns and movements of enemy units and subunits (tanks, APC's, weapons, etc.). The analyst's task is to detect/deduce the enemy's choice of combat options and the friendly force's vulnerability to attack, breakthrough and other threat actions. For the corps echelon examined herein, the analyst is typically interested in movements/intentions over the next 24 to 36 hour period which represent major threats to the friendly force posture by enemy forces of division size or larger.

As seen on the figure, the analyst has available for rapid call up and display a hierarchy of IPB products, including enemy options, situation snapshots, situation templates and event templates. A group of snapshots taken in sequence represent the execution of one enemy major option directed at accomplishment of a certain objective.

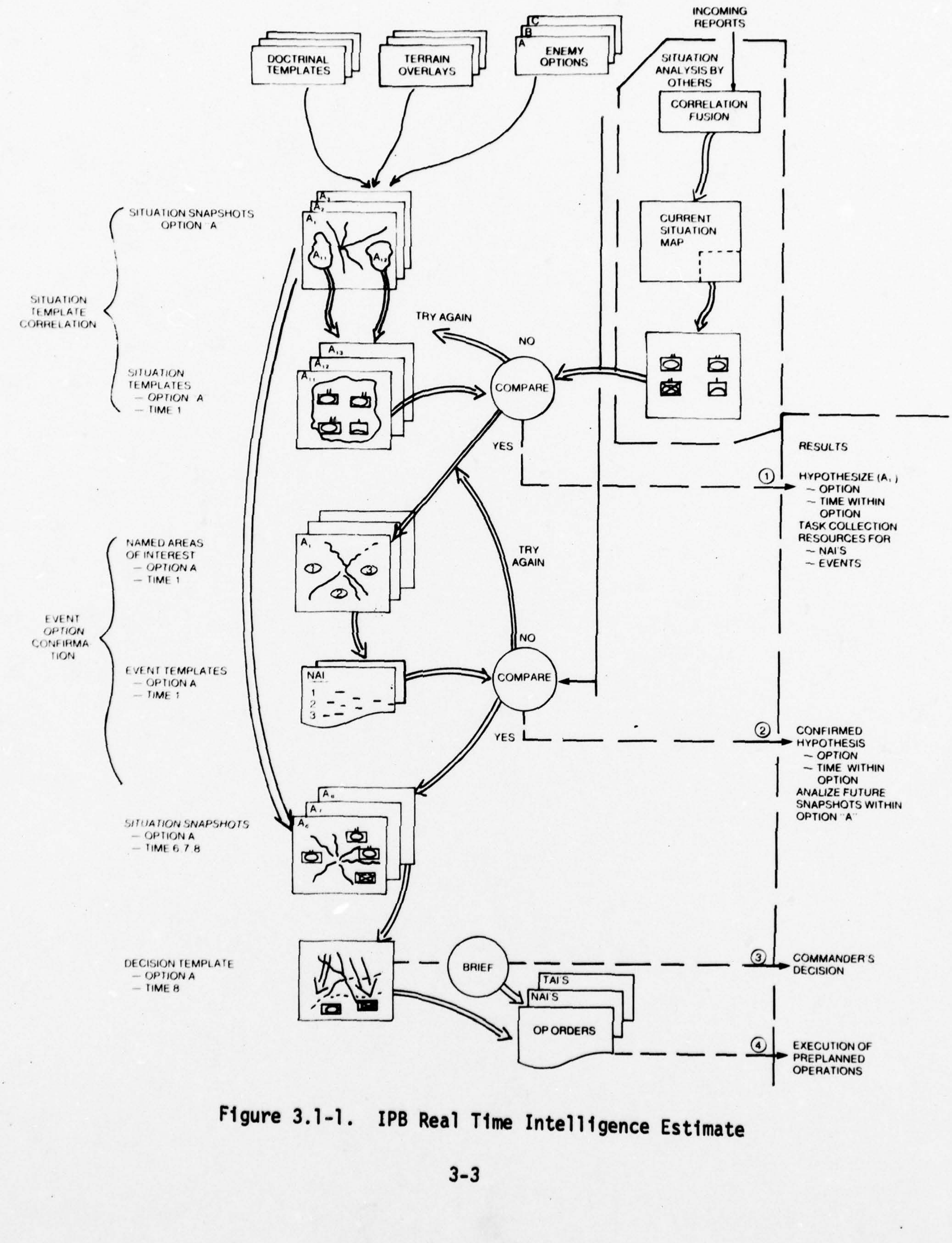

Figure 3.1-1. IPB Real Time Intelligence Estimate

Situation templates are subsets of snapshots. A situation template represents a small array of enemy force elements which have been identified from a snapshot and discriminate that option from all other options available to the enemy. The analyst superimposes and tests situation templates against detailed areas/events represented on the current military situation map. By repetitively trying, modifying and retrying situation templates, he can hypothesize that the enemy has elected a certain option and is at a certain time or point in that option sequence. This activity is referred to as situation template correlation and is discussed further in Section 3.2.

Having postulated that a particular option has been embarked on by the enemy, the analyst proceeds to confirm of reject the hypothesis. This involves monitoring of named areas of interest to detect anticipated events and the conditioning of input system control parameters to notify the analyst immediately if any returns are received that meet his specified criteria so that he can rapidly evaluate and confirm his hypothesis. This process is referred to as event/option confirmation and is discussed further in Section 3.3.

Having confirmed an hypothesis, the analyst has achieved a high confidence that he has "caught" the enemy at a certain option and point. He may then form an intelligence estimate which he does in the form of a decision template. If he has confidence that he has "caught" the enemy sufficiently early in the option, he will select a later snapshot from the series of situation snapshots for that option, one that offers the commander the time needed for redeployment of forces and the best terrain for blocking and interdiction actions. He updates this future snapshot template to reflect the current situation; it then serves as a basis for briefings to the commander and TOC staff members. It facilitates planning of where to interdict, where to fire and where to maneuver.

3.2 IBP SITUATION TEMPLATE CORRELATION (Figure 3.2-1)

The analyst has available a series of situation snapshots for each option. Each snapshot depicts the entire enemy force array disposition at one point in an option. A series of 5 to 15 snapshots taken together may represent the execution of one enemy major option directed at accomplishment of a certain objective.

Situation templates are those specific sections of a snapshot that allow the analyst to differentiate one option from another. These are typically characterized by type of unit, or size of force in a particular area at a point in the option sequence. The situation template is a unit representation of an element of the enemy force arrayed over an analyzed portion of terrain at a point in time or option sequence. A number of these will be stored and referenced to each option. The situation templates are the key elements of each situation snapshot that differentiate one option from another.

The analyst examines as many of these situation templates as necessary, visually comparing each to elements of the current situation display, and selects one or more situation templates that appear to fit the enemy situation in a particular area or corridor. He attempts to identify the enemy as early as possible in the execution of an option. The preplanned situation templates will probably never exactly match the current situation map. The analyst may have to vary the configuration of units on the situation template to adjust for weather impact on enemy mobility, or for known changes in enemy forces or terrain due to interdiction actions, or for other reasons not anticipated at the time the situation templates were created. If necessary, situation templates should be modified in real time to incorporate current knowledge of the situation, and the analyst should retest the modified templates against elements of the situation map. In other words, the

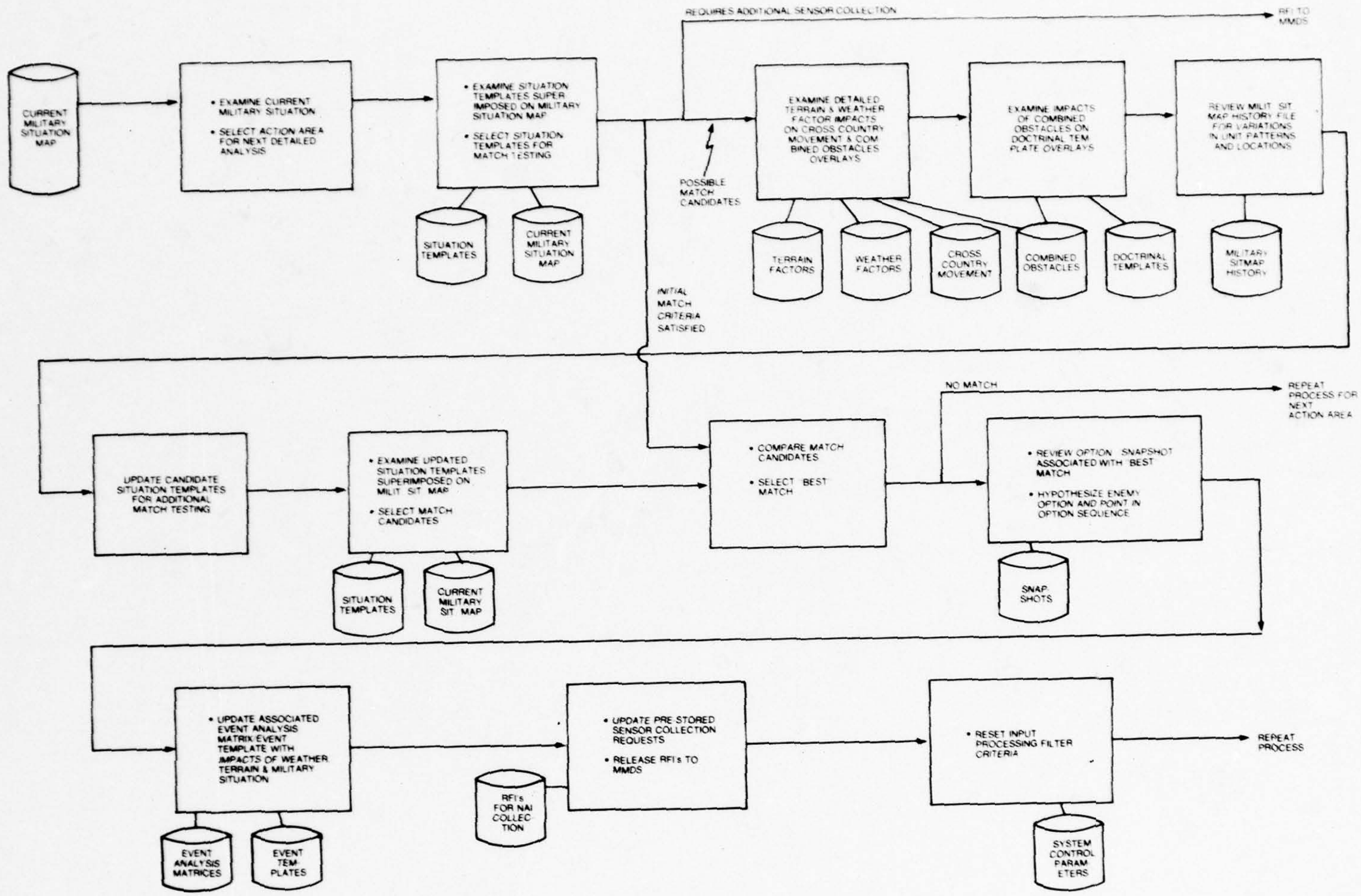

Figure 3.2-1. IPB Situation Template Correlation

situation template is a guide--the analyst must use common sense and current knowledge in attempting to match stored situation templates with the situation map.

At times, data available to the analyst from current reports may be insufficient to pinpoint a single option and he is forced to monitor multiple enemy options. However, if he has established sufficient information to think he has a match between a situation template and a portion of the current situation map, he forms an hypothesis that the enemy is following this option and is at this snapshot within the option.

He now initiates system actions to aid him in confirming the hypothesis. These actions include (1) initiating RFI's (request for information) to the MMDS (Mission Management and Dissemination Section) requesting that they focus collection efforts on specified targets for the immediate future, and (2) resetting input report filters to cue the system to forward directly any input responding to stated criteria. The analyst uses event analysis matrices and event templates as aids in levying requirements on MMDS.

The event analysis matrix is an ordered sequence of subevents (e.g., new artillery position, CP relocation, tanks moving through a choke point) that can be expected to follow shortly (within a few hours) after the point represented by the situation template. These are near term activities which are predicted based on enemy doctrine and known terrain/obstacle characteristics. The matrix links subevents to named areas of interest (NAI's). The event template is a graphic display of the same information using special symbols for subevents and showing them at NAI locations. Because the event analysis matrix/event template were prepared in advance of conflict and actual conflict may have introduced new factors, the analyst may elect to call other

prestored graphic data in order to fine tune these items before taking action to direct collection resources towards them. Adjustments to the event analysis matrix/event template could include adding a new subevent, reordering a sequence, changing NAI boundaries, etc.

The analyst requests the MMDS (Mission Management and Dissemination Section) to task additional sensor collection resources. The analyst specifies the event analysis matrix against which the request is being made (matrix is stored in both the MMDS and IPB files) and the specific subevents/characteristics he wants monitored.

The analyst conditions the input filtering process to test incoming reports and automatically route alert line messages to his station for the NAI's and activities of interest. Filters are adjustable to select intelligence information on the basis of factors including age (time), area (NAI), activity/target category, worth and location accuracy. Filters may also be set to accumulate reports in specified NAI's and alert the analyst when a specified threshold is exceeded. Filtered information is prioritized and routed to the appropriate analyst. Information relevant to any event analysis matrix that he has specially flagged will receive highest priority.

At this point, the analyst has established an hypothesis, has directed collection resources to look for a specific event or series of events, and has cued the system to alert him if he gets any response representing confirmation of an event he anticipated. He can also cue the system to notify him if no positive responses are received within a specified time period. He now continues to monitor the situation map against his file of situation templates.

3.3 IPB EVENT/OPTION CONFIRMATION

Figure 3.3-1 shows in greater detail the steps for using the IPB products for event/option confirmation. When a report is received satisfying the filter criteria, the analyst is signalled by an automatic alert line and at the earliest time calls the full message text from the queue. The message will reference an RFI and/or NAI and the associated event analysis matrix. After reviewing the event analysis matrix the analyst proceeds with steps leading to confirmation of the events reported, i.e., were these the events he expected to see when he established his hypothesis. Again, he has the facility to examine a wide range of graphic overlay material. He may superimpose event templates on the current situation map. He calls individual terrain and weather overlays to examine in more detail these subfactors. If terrain has been water saturated, or if subfreezing temperatures exist, he uses programmed algorithms to rapidly recompute and display the impact on mobility that these factors have and the change in unit location/configuration as a result. He calls detailed technical data on roads, bridges, streams, rivers and railroads. He can call and re-examine doctrinal templates, situation snapshots and situation templates adjusting any of these to more accurately reflect new intelligence and improved terrain and weather data.

Through this process, he confirms events and updates the event analysis matrix. He confirms or rejects the hypothesis that a particular enemy option is being followed.

If his hypothesis is confirmed, the analyst has established that he knows with high confidence which option the enemy is pursueing and where he is in that option. This allows him to take more positive actions toward direction of friendly forces. He can again guide collection resources, using preplanned automation aids. For example,

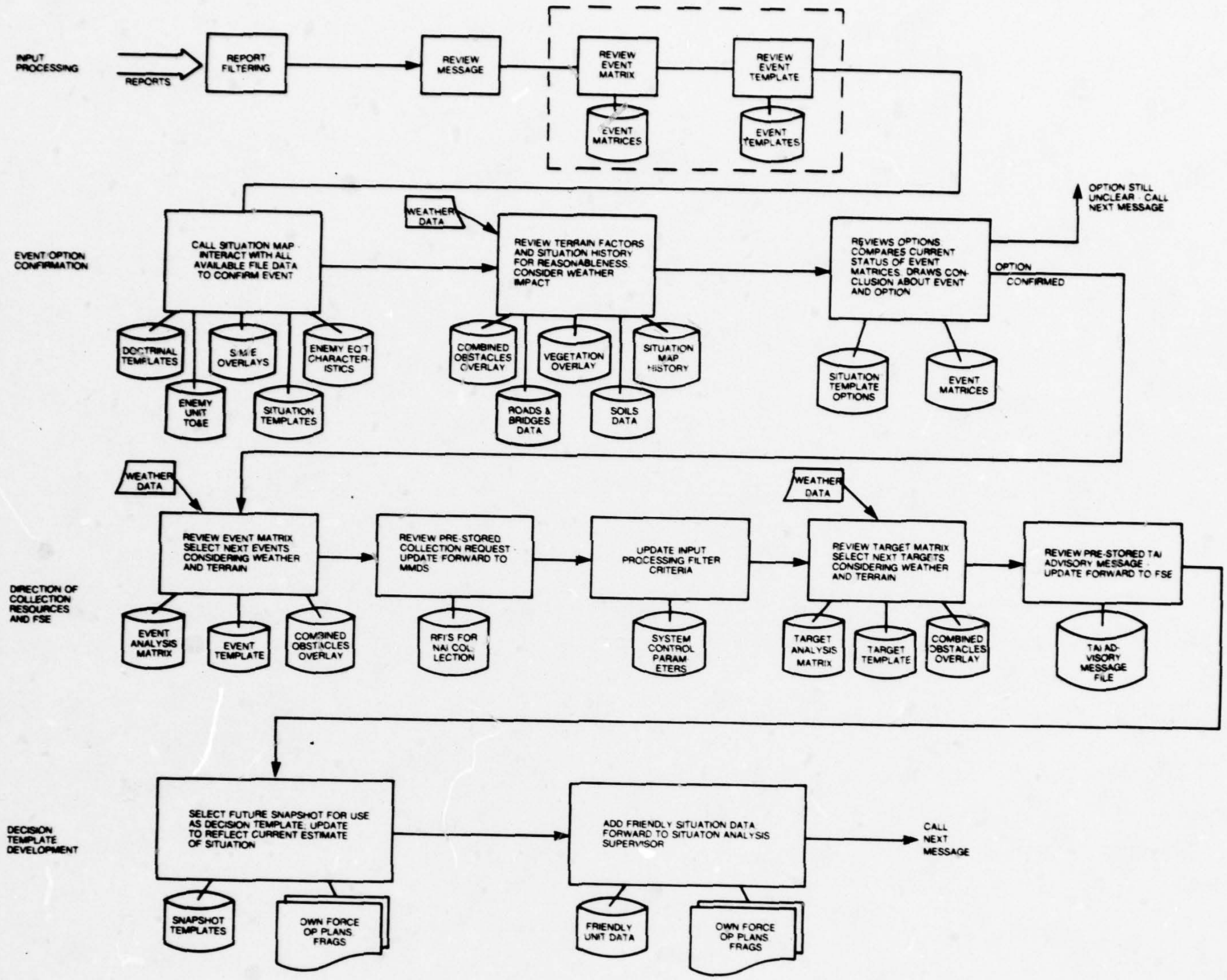

Figure 3.3-1. Event/Option Confirmation

situation templates, event analysis matrices and event templates could be stored both by this analyst and the MMDS function. When the analyst wants to request sensor tasking for a selected situation he can do so by sending a simplified message (RFI) asking that collection be implemented to seek detections of events in accordance with a specified matrix.

Again, the analyst can cue the input processing system to notify him immediately upon receipt of any messages that meet his specified criteria. He can also set a time limit by which he wants notification if no responsive messages are received.

In addition to the event analysis matrix and event template formats, there are target analysis matrix and target event templates which are built in the pre-conflict IPB period. During a conflict, upon determining which option the enemy is pursuing, these are reviewed by the analyst and may be modified to reflect the most current situation reports. They are sent to the FSE function in the CTOC and represent a list of anticipated targets which can be monitored closely by the FSE for possible firing action during the time period immediately following.

Finally, and perhaps most significantly, with the analyst's confirmation that he knows which option the enemy is pursuing and at what point he is in that option he can next update his intelligence estimate. He does this by selecting a snapshot several hours later in the option which can provide the friendly commander a suitable situation for planned interdiction and blocking. The analyst makes adjustments to this snapshot based on the current intelligence situation. This becomes the basis for briefings to the commander and his G-2/G-3 staffs. It can also be a valuable point of departure for the G-3 staff in their determination of where and when to deploy blocking forces. The same terrain data used by the IPB analyst can also be used by the G-3 in maneuvering friendly forces.

The foregoing discussion traces a single thread of analyst activity. The analyst undoubtedly will be called upon to follow multiple options and template possibilities. The function provided by the automated data management/graphic display system is primarily to allow him to narrow the choices and focus on likely enemy threats more rapidly than he could with only manual aids at his disposal.

SECTION 4. IPB PRODUCTS

This section describes those IPB -related products which are required to support the real time implementation of IPB concepts. These products are displays and data bases which will be utilized by the intelligence analyst in developing his intelligence estimate as well as those products provided to the FSE and G-3 which result from the IPB process. For clarification of the discussion that follows, a list of IPB template and overlay definitions is provided in Table 4-1 at the end of this section.

Figure 4-1 identifies the files and displays that are built by service support group and corps intelligence in advance of hostilities. The hierarchy of build steps is obtained by reading from the bottom up on the figure.

The numbered items 1 through 10 along the bottom row of the figure are items whose preparation requires scientific and map-making skills (geologist, hydrologist, soil mechanics, engineering, etc.) well beyond the specialist training available in the field army. The source information for these items comes from detailed topographic maps, high resolution aerial photography, etc., and its conversion to a form suitable for IPB application requires special skills and data. Such materials must be prepared by trained service support agencies.

In addition, the materials for numbered items 14 and 15 on the figure must have wide DoD acceptance and will be accomplished by specially qualified service support personnel. These materials are the organizational data and spatial templates that define enemy military unit personnel and equipment strengths along with the doctrinal force arrays and maneuver actions/rates to execute various combat actions.

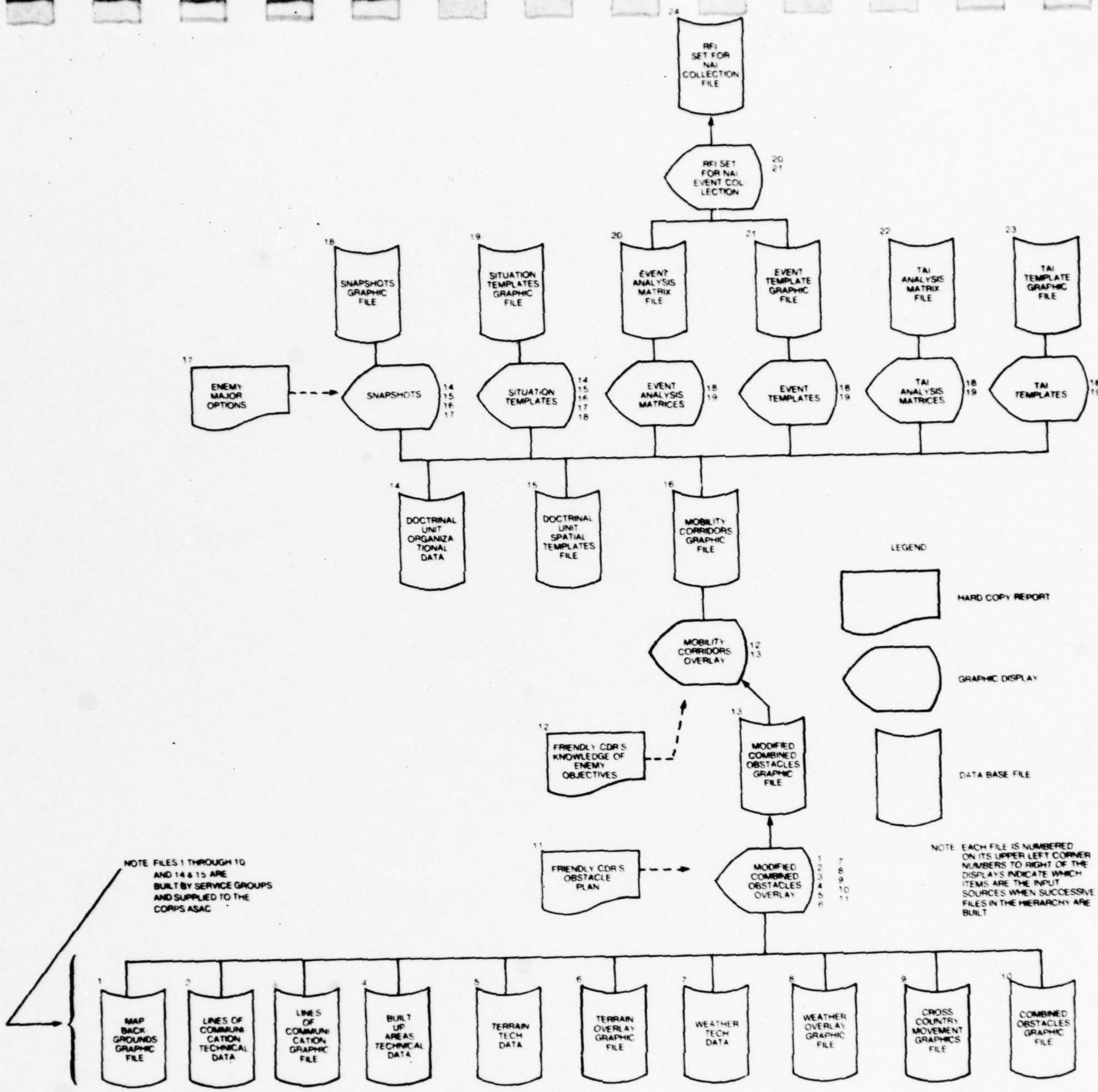

Figure 4-1. IPB Files and Displays Constructed Prior to Hostilities (Read From Bottom Up For Hierarchy of Build Steps)

Other files and displays shown on the figure are items which must be prepared by the local command because they stem from direct military intelligence estimates/judgments of the enemy's tactical objectives and estimates of current strengths/vulnerabilities of both friendly and enemy forces. To the maximum extent possible these are prepared in advance of hostilities. They are apt to require modification/updates as the potential for conflict escalates. Generally speaking however, the objective of friendly intelligence is to proceed as far as possible with preparation of IPB materials in advance of a conflict. This implies availability of preparation time and depth of IPB analysis that foresees most of the significant possibilities for enemy choice of major options and method of execution. If such is feasible then the effort required to modify and fine tune as hostilities are initiated is made a more manageable task and the job of realtime intelligence analysis is enhanced through use of the IPB automation aids.

The three basic symbols on the figure differentiate between hard copy files, automated files and automated displays per the legend. On the second line from the bottom the display symbol reads "Modified Combined Obstacles Overlay." To the right of the display symbol appear the numbers 1 through 11 signifying that to build his Modified Combined Obstacles Overlay, the analyst requires all or some subset of the data from those basic files. The figure should not be interpreted as a flow because the purpose is not to show steps and interactions of the process. The solid lines connecting the file symbols on the bottom to the Modified Combined Obstacles Overlay symbol signify that the data is shifted/displayed via computer graphic or alphameric screens. The dashed line from item 11 (Friendly Commander's Obstacle Plan) signifies that this data is not in machine form but is utilized by the process in hard copy form.

Progressing through this hierarchy of file/display build activity the primary output can be viewed as a set of display graphics (labeled 18 through 24), all of which are prepared and stored prior to hostilities.

Figure 4-2 identifies the files and displays for use during real time application of IPB techniques. The two bottom rows of symbols are files that contain the analyst's input information. The upper two rows are the files/displays that represent his product or output to other corps echelon users. Items 32, 33 and 34 are intended to be different than files 13, 16 and 24, respectively. The distinction is that file 16 for example contains the total set of Mobility Corridor graphics information available to the analyst whereas file 33 will contain only that Mobility Corridor graphics information that the analyst declares as applicable in an actual conflict situation and he therefore elects to release for use by other corps intelligence and TOC functions.

Note that on the bottom row, the files shown are identified to be those dominantly used in a real time conflict. The analyst may also use any of the sets of templates and terrain/weather factor overlays of Figure 4-1, it is anticipated that such items would be used less frequently and serve mostly to backup the dominant set itemized on Figure 4-2.

A detailed list of the files and displays is provided in Appendix A1, hereto.

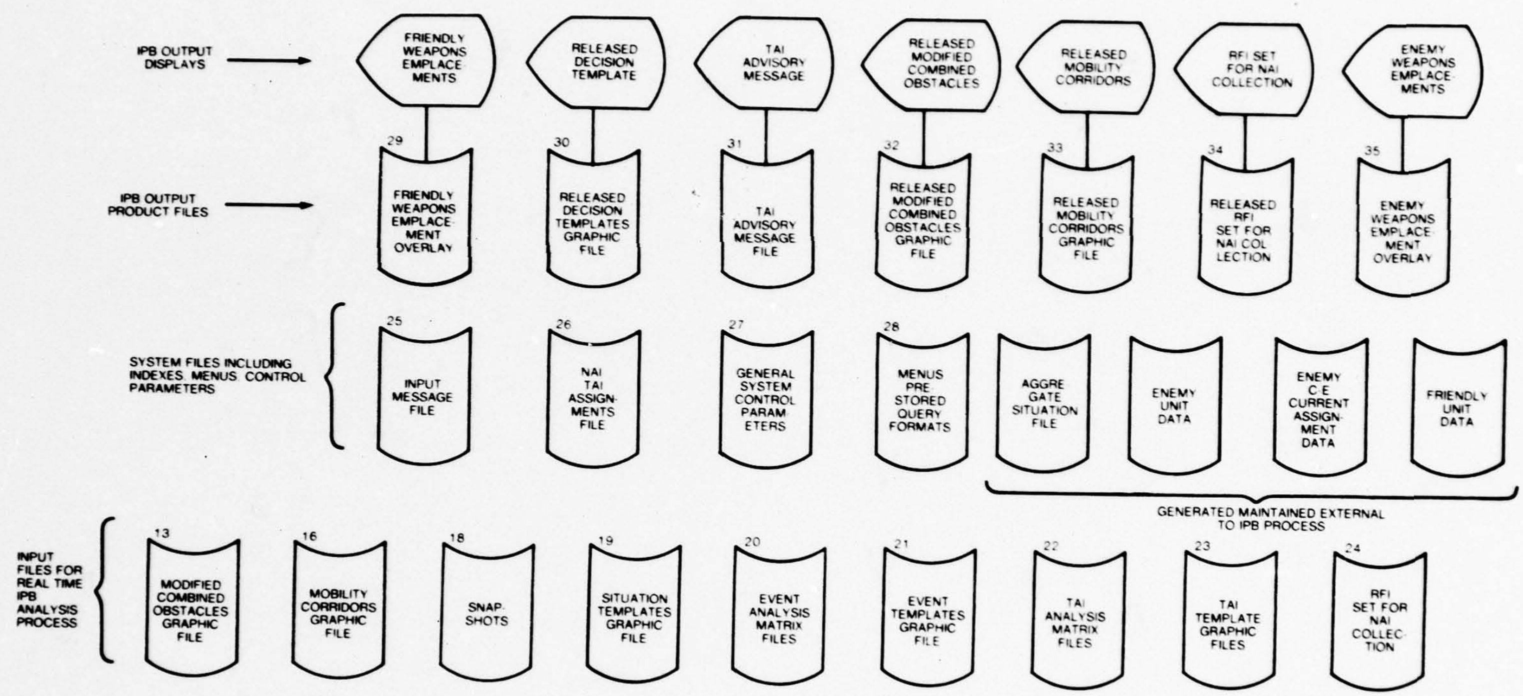

Figure 4-2. IPB Files and Displays (Real Time Use in Hostile Action)

Table 4-1. IPB Definitions

OPTION	One of several alternative enemy battle plans - covers period from wherever he is now (usually at beginning of hostilities) to his achievement of major objectives.
DOCTRINAL TEMPLATE	A graphic showing composition (unit make-up) and disposition (ground spacing) of an enemy unit based on doctrine without consideration of terrain or weather factors. Can be constructed for various types of units at any echelon. Will vary depending on enemy mission (i.e., attack, defense, etc.).
SITUATION SNAPSHOT	Graphic of postulated overall enemy unit locations at an instant in time in a single option on analyzed terrain. Some 5 to 15 snapshots along mobility corridors may be required to represent the execution of one option from inception to objective.
SITUATION MAP	Actual current enemy and friendly unit/force locations - as known or estimated right now.
SITUATION TEMPLATE	A portion of a situation snapshot showing only those postulated unit locations at a point in time which enable analyst determination that the enemy is indeed pursuing this option--i.e., will allow him to distinguish between this and other options. It is a graphic that shows unit configurations at locations on analyzed terrain. Numerous situation templates may be associated with one situation snapshot.
EVENT ANALYSIS MATRIX	Time ordered sequences of events (enemy activity that is recognizable in near real time from a single report or small group of reports) that immediately follow the time period represented by the situation template they relate to. They focus on recognizable, near-term activities in time sequence, and relate geographic location to each event by NAI's. Event analysis matrices are in the form of A/N tabular listings. The geographic layout of the NAI's associated with a given event analysis matrix is an event template.

Table 4-1. IPB Definitions (Sheet 2 of 4)

NAI (NAMED AREA OF INTEREST)	Specified portion of terrain that will contain one or more of the events predicted in the event analysis matrix. They are normally identified during planning cycle, and their locations are shown on event templates.
EVENT TEMPLATE	Graphic layout of the NAI's aassociated with a specific event analysis matrix. Indicates NAI number and location as well as sequence number of each NAI within that event analysis matrix.
TARGET ANALYSIS MATRIX	A/N tabular listing similar to event analysis matrix but listing potential targets that FSE should monitor closely during time period immediately following that of the target analysis matrix the situation template relates to. Targets listed on the target matrix may or may not also be listed as events on the event matrix. The geographic layouts of targets in the target matrix are called target areas of interest (TAI).
TAI (TARGET AREA OF INTEREST)	Same as NAI's except showing areas listed in the target analysis matrix.
DECISION TEMPLATE	A situation snapshot representing the analyst's current best prediction of enemy unit locations/formations and friendly unit locations at some point in the future. Could be thought of as the final situation snapshot of the option series the analyst thinks is being implemented, as updated by his current knowledge of the battle situation.
WEAPONS EMPLACEMENT	A graphic representing the artillery, air defense and missile emplacement predicted for use by a large enemy force when conducting a specific option over analyzed terrain. Communicated to the G-3 and FSE functions by the IPB analyst as part of his decision template briefings.
MAP BACKGROUNDS	These are outline maps including only major map features such as large bodies of water, rivers, bridges, primary and secondary roads, city and built up area outlines. A minimum of terrain features such as key elevations may be shown. A standard military grid reference is shown. Maps are displayed at any of a range of scales under analyst control. Map backgrounds are normally superimposed with the military situation displays and terrain and obstacle overlays.

Table 4-1. IPB Definitions (Sheet 3 of 4)

LINES OF COMMUNICATION OVERLAY	This overlay provides mobility classifications for the roads, bridges and railroads. A network of roads on this overlay is differentiated by colors to show mobility of mechanized forces in up to 5 gradations. Additional data describing road, bridge and railroad width, gauge, construction, load bearing capacity, etc., are available in a related technical data file.
BUILT UP AREAS OVERLAY	This is an overlay indicating the geo-outlines of metropolitan areas cities and large towns. These areas are treated as blocked or no-go zones when merged into the cross-country movement overlay. When merged with lines of communication in the combined obstacles overlay, built up areas may become traversible in one of the road mobility categories provided that main routes and streets through the area are generally aligned with the basic corridor direction of concern to the analyst. Additional data describing in-city street and bridge widths and load bearing capacities, location of water supplies, location of reinforced, bomb resistant buildings, etc., are available in a related technical data file.
TERRAIN FACTOR OVERLAY	Individual overlays for slope, vegetation, soils and wetlands (hydrology) are included in this set. The first three are prepared for display as mosaics in which differing color and intensity (density of dot patterns) are used to show mobility in up to 5 gradations. The basic mobility grade of each elemental square is entered for a "hot July day." Variants are prepared to represent changes for other seasonal conditions (i.e., vegetation state in winter; soil classification in wet season or in sub-freezing temperatures.
WETLANDS OVERLAY	The wetlands overlay is a representation of large bodies of water, rivers and streams. Segments are differentiated by color to show mobility of mechanized forces making crossings in up to 5 gradations. Variants are prepared to represent changes to mobility grades of crossings under extreme flooding conditions or freezing.

Table 4-1. IPB Definitions (Sheet 4 of 4)

CROSS-COUNTRY MOVEMENT OVERLAY	This overlay is a composite of the four terrain factor overlays plus the effects of the built up areas overlay. An algorithm technique will be designed to automatically combine the individual factors starting with the mobility classification attributable to slope and degrading that classification successively as each further factor is introduced. This overlay is also prepared in up to 5 mobility gradations.
COMBINED OBSTACLES OVERLAY	This overlay is a composite of the cross-country movement overlay and lines-of-communication overlay. Merging of lines-of-communication factors further modifies the composite mobility picture or its inverse, the combined obstacles overlay. Thus, lines-of-communication roads may cause a no-go built up area to be converted to one of the go classifications. Lines-of-communication bridges may result in reclassifying a river barrier from a VERY SLOW category to a GO category.
OBSTACLE PLAN OVERLAY	This is a graphic representation of the friendly commander's barrier plan showing planned interdiction, mining and demolition blocks to deny or severely impede or rechannel enemy advances.
MODIFIED COMBINED OBSTACLES OVERLAY	This is a version of the combined obstacles overlay further modified reflect the effects of an implementation of the friendly commander's obstacle plan.
MOBILITY CORRIDORS OVERLAY	This overlay is derived by analysis of basic battalion mobility over cross-country terrain and over lines of communication. The analyst, working directly on the graphics display of combined obstacles has the capability to construct and grade by mobility category the corridors available to enemy battalions. Having measured and graded corridors for this basic mobility, he can construct and color the corridors most likely to be utilized by the enemy for specific force sizes in specific actions.
WEATHER OVERLAY	This is a graphic presentation which is used to show boundaries of general meteorological conditions (precipitation, fog, wind condition) over the areas of interest to the Corps and Division as predicted by short range forecasts.

SECTION 5. MOBILITY CONCEPTS FOR AUTOMATED TERRAIN OVERLAYS

The purpose of this section is to define a specific approach to applying IPB concepts in the development of automated graphic terrain overlay presentations. The objective of this effort is not to develop methods of storage and presentation of detailed terrain data, but rather to develop simplified graphics which provide the tactical command center analyst with a rapidly interpretable picture of the military significance of the terrain under consideration. The goal is to reduce to a minimum the complexity and detail of the terrain associated data which must be automated at the tactical command center, while retaining its military impact.

In order to achieve this goal the specific objectives of the IPB terrain analysis are as follows:

- The level of detail and complexity of the data presented must be kept consistent with the use at echelons where command centers would be automated (division or above)
- The development of terrain presentations must be oriented toward rapid interpretation of significant terrain features
- The net effects of terrain on military actions must be presented with traceability to individual terrain factors
- A mobility concept is required which will allow a quantitative expression of the effects of terrain on military ground force movement

- An approach to defining mobility corridors must be developed which permits a simplified presentation of likely corridors of high mobility for military ground forces

- The approach must allow for the effects of friendly force action, e.g., interdiction, mine fields, and demolition

- The approach must be viable for either enemy or friendly force movement

5.1 A MOBILITY CONCEPT FOR AN AUTOMATED IPB

One of the key features of Intelligence Preparation of the Battlefield is to present terrain data in terms of its effect on ground force mobility. This is usually done by identifying terrain in one of these categories: GO, NO-GO, and SLOW. This approach is the necessary first step in evaluating terrain in terms of its effects on mobility. However, some refinement of this approach is needed in order to make the concept fully effective in an automated command center.

The three categories utilized do not provide any quantitative measure of ground force mobility across selected terrain. "GO" must equal some theoretical rate of advance to have significant meaning. Similarly, the size and type of force which must traverse the terrain will also determine whether it is "GO" or not. Terrain which is suitable for the rapid advance of an infantry company may not be sufficient to pass a division.

To address these considerations, the approach taken in this analysis is threefold:

- To provide a quantitative measure of the rates of movement across battlefield terrain
- To permit that quantitative measure to be applied to varying size forces
- To divide the battlefield terrain into mobility categories which have specific military significance.

Throughput

The mobility concept developed to express the net effect of terrain on military ground force movements is to determine the number of battalions per hour that can traverse the terrain. Use of this simple quantifier permits the analyst to rapidly assess the time of passage of any force of battalion size and larger across selected terrain. In using this approach there are two types of mobility which must be considered. The first is cross country, and the second is along roads or other lines of communication. The mobility in cross country terrain is defined as the number of equivalent battalions per hour which can pass a linear kilometer of front. Where there are no terrain impediments this number is determined by assuming a red force* advance in a stylized front (Figure 5.1-1) moving at the doctrinal rate of 12 KPH for mechanized forces. In the stylized attack a mechanized battalion advances across 1.5 Kms of front and the battalion depth is 3 Kms. At 12 KPH 4 battalions per hour would pass in succession across a 1.5 Km front. For each kilometer of front the equivalent of 2.7 battalions per hour will pass. The basic measure of mobility for cross country movement for terrain which offers no impediments is 2.7 battalions per hour per kilometer of front.

*Primary reference source is FM 30-102 (18 November 1977) "Opposing Forces Europe".

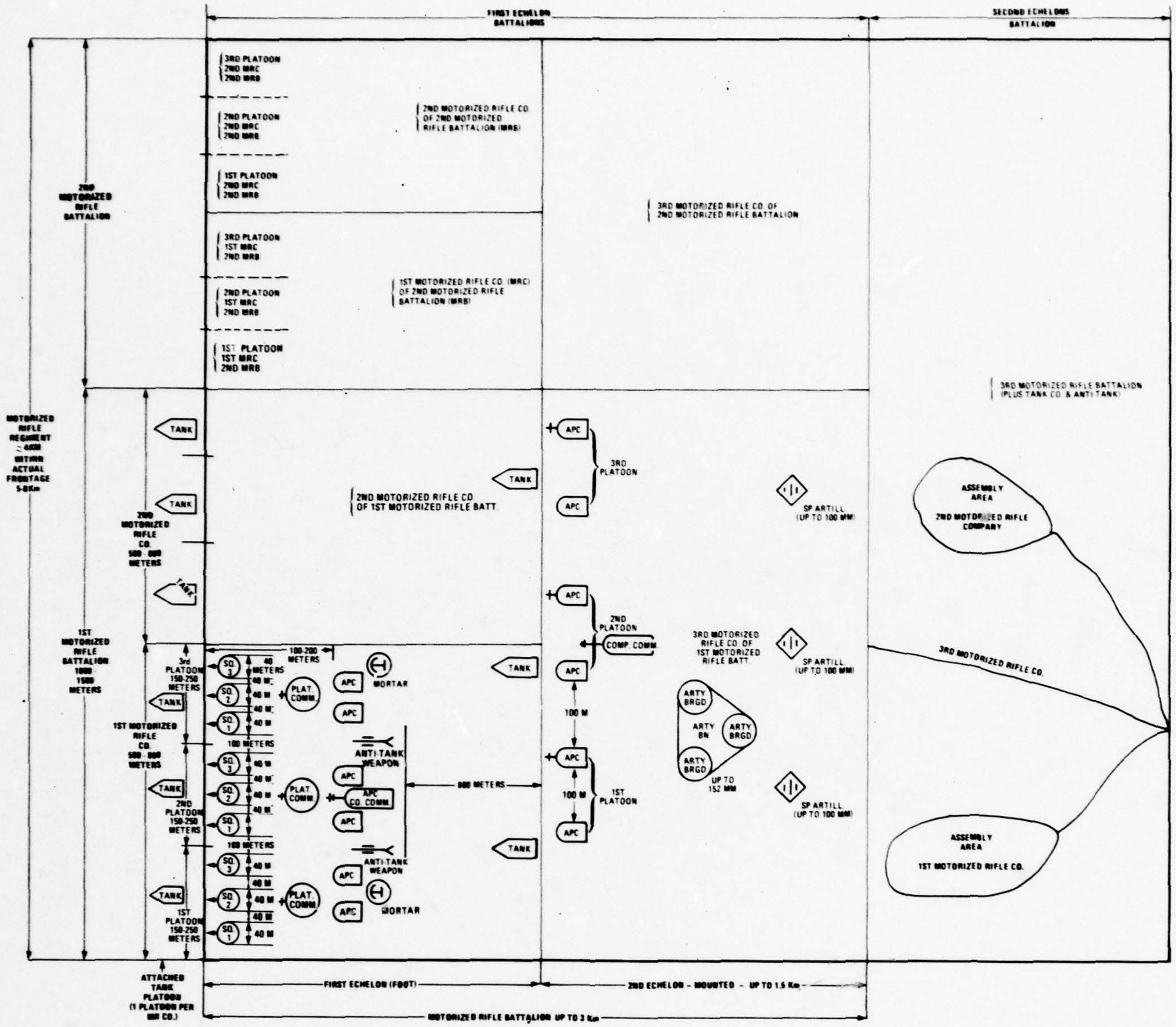

Figure 5.1-1. Nominal Motorized Rifle Regiment

For lines of communication a similar measure has been developed for linear traffic along roadways or other lines of communication. This measure is based on a battalion moving in column with specified vehicle separation between vehicles and between battalions while traveling at the doctrinal rate of 25 KPH. For this rate of advance the equivalent mobility is 5.5 battalions per hour. Since road traffic must also accommodate wheeled vehicle traffic in excess of the combat battalions, a second measure of mobility is provided for lines of communication which defines the time to pass a full division. Using doctrinal rates of advance and vehicle spacing this time is 4.2 hours for primary roads.

Mobility Categories

Having defined a measure of mobility in terms of battalions per hour, it is necessary to now define a set of categories which have military significance and to determine the nominal measure of mobility for each category. There are five categories of mobility selected. These are as follows:

GO: This identifies terrain which will nominally support the doctrinal rate of advance of 2.7 battalions per hour per kilometer of front or 5.5 battalions per hour for lines of communication

INHIBITED: This represents a degradation, caused by the terrain, to less than one half of the doctrinal rate of advance (nominally 1.4 battalions per hour per kilometer of front)

SLOW: This represents a degradation, caused by terrain, to the doctrinal rate of advance of dismounted infantry (nominally .6 battalions per hour per kilometer of front)

VERY SLOW: This represents a degradation, caused by terrain, where any advance is dependent on unusual engineering support, e.g., pontoon bridging, or road clearing (nominally .2 battalions per hour per kilometer of front)

STOP: This represents terrain through which passage is blocked to a battalion.

5.2 TERRAIN OVERLAYS FOR AN AUTOMATED IPB APPROACH

Traditionally the presentation of terrain data for military purposes has been accomplished by the use of the basic 1:250,000 or 1:50,000 map, occasionally accompanied by selected topical maps such as "rock types," soils, drainage, or vegetation. The types and quantity of data provided in hard copy form are enormous when considered in terms of digital storage. For example, a recent activity undertaken for the operational forces in Europe by the USA Engineering Topographic Laboratories is producing 1:50,000 scale terrain overlays for selected potential combat areas. To accomplish this each 1:50,000 scale map segment is accompanied by 11 individual overlays. Each overlay itself is a considerable undertaking involving characterizations of up to five or six hundred map segments as small as a few hundred meters in diameter. This is an extremely labor intensive process requiring great skill and judgment and a large amount of basic data.

In addressing the terrain overlay requirements for an automated IPB, there is a distinct advantage in being able to define the use to which the data will be put and in tailoring its use to division echelon or higher. It is possible, therefore, to simplify the terrain overlays and the requirements for raw data needed to generate these overlays.

Figure 5.2-1 indicates the factor overlays that have been chosen for presentation of terrain data. These are divided into two categories; cross-country factors, and lines of communication factors. The first includes slope, vegetation, soils, and wetlands. The second includes roads, bridges, and railroads and built-up areas. Each of these factor overlays when used alone will indicate the level of mobility when only the single factor is considered. For example, the basic slope overlay presents the terrain in the five categories of mobility if only the effects of slope are considered. Each successive overlay will further degrade cross-country mobility with a composite cross-country mobility overlay as the complete result. When this cross-country mobility overlay is superimposed with the lines of communication overlay a total combined obstacles overlay is the result. In each case of the individual factor overlay and the combined obstacle overlays the terrain is presented in terms of the five categories of mobility using the basic measure of throughput, i.e., battalions per hour or battalions per hour per kilometer. The basic factor overlays are based upon good mobility conditions as on a "hot July day."

In addition, each of the factor overlays for a given area may have one or more variations depending upon the weather, and the time of year. For example, thy soils will include a separate overlay for water saturated soil, and for temperatures well below freezing. The vegetation overlay is less dependent upon weather as time of year. The wetlands has several variations, one for heavy precipitation, one for time of year (when flooding conditions exist) and one for temperature well below freezing.

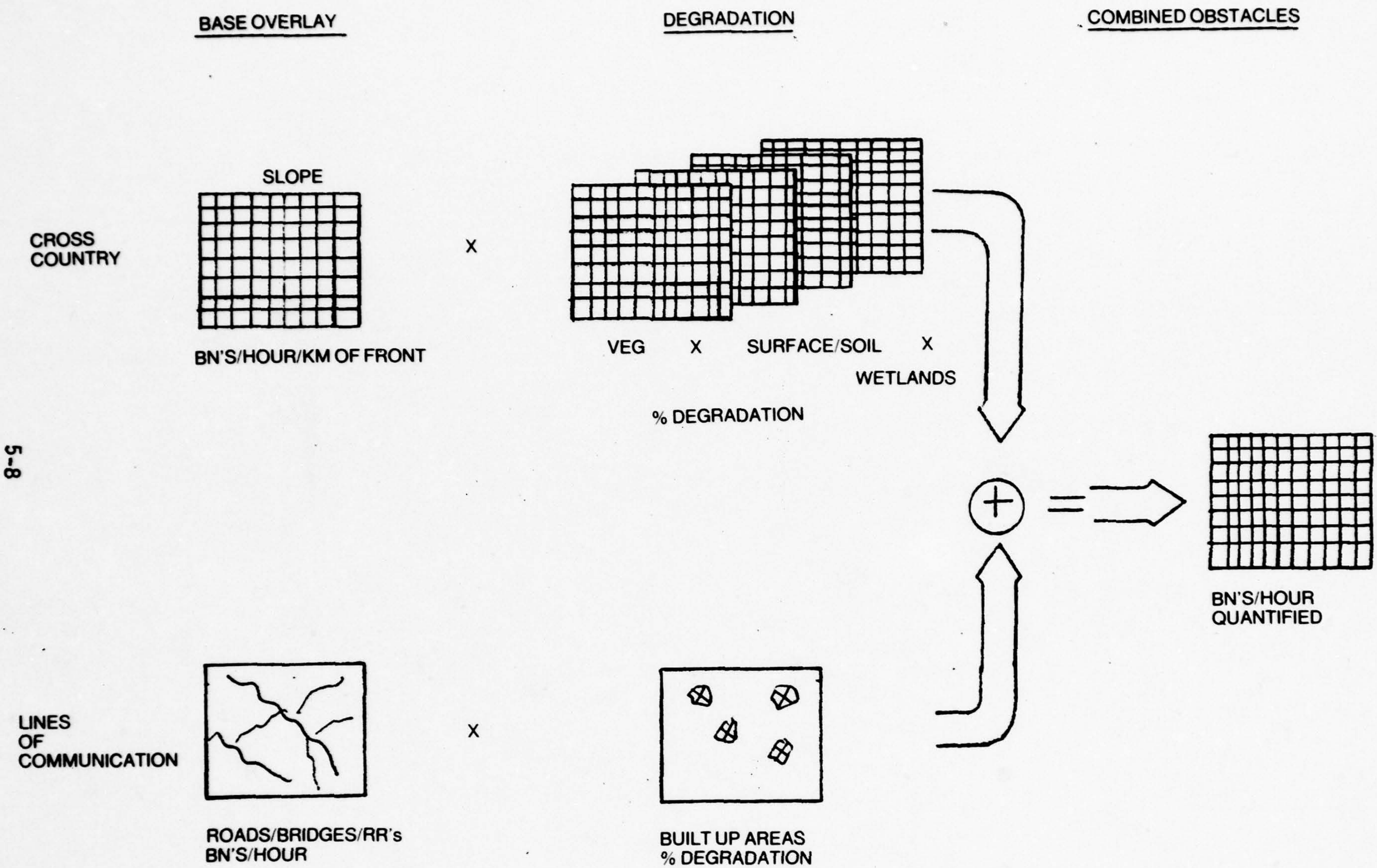

Figure 5.2-1. Basic Terrain Overlays

This set of overlays and variants is aimed at representing the terrain's mobility characteristics. Other characteristics such as line-of-sight, aerial concealment, and intervisibility will be similarly addressed in Phase B of the TIAX Program.

The selection of the proper factor overlay for existing conditions must be a judgmental factor by the analyst depending on weather and climatological information. When factor overlays which are variations from the "hot July day" are used, the accompanying mobility degradation or enhancement must be made to the combined obstacle overlay to effectively use this tool. This can be accomplished in an automated system because each of the individual areas can be digitally addressed and superimposed. Figure 5.2-2 indicates the form of the digitized overlay for which the terrain is divided into small squares each of which is several hundred meters on a side. Each square within each factor overlay has been assigned one of the five mobility ratings. The effects of the factor overlay variations due to temperature, precipitation, or time of year may be determined by sequentially combining the factor overlays (using the proper variations). A single algorithm within the automated system will determine for each basic square the resultant net degradation for that square from all factors. The result of this process is the production of a combined obstacles overlay for the existing conditions rather than the "hot July day." Normally, the "hot July day" combined obstacles overlay will be prestored while variations to it are developed in real time.

Figure 5.2-3 summarizes the characteristics of each of the factor overlays and its variations.

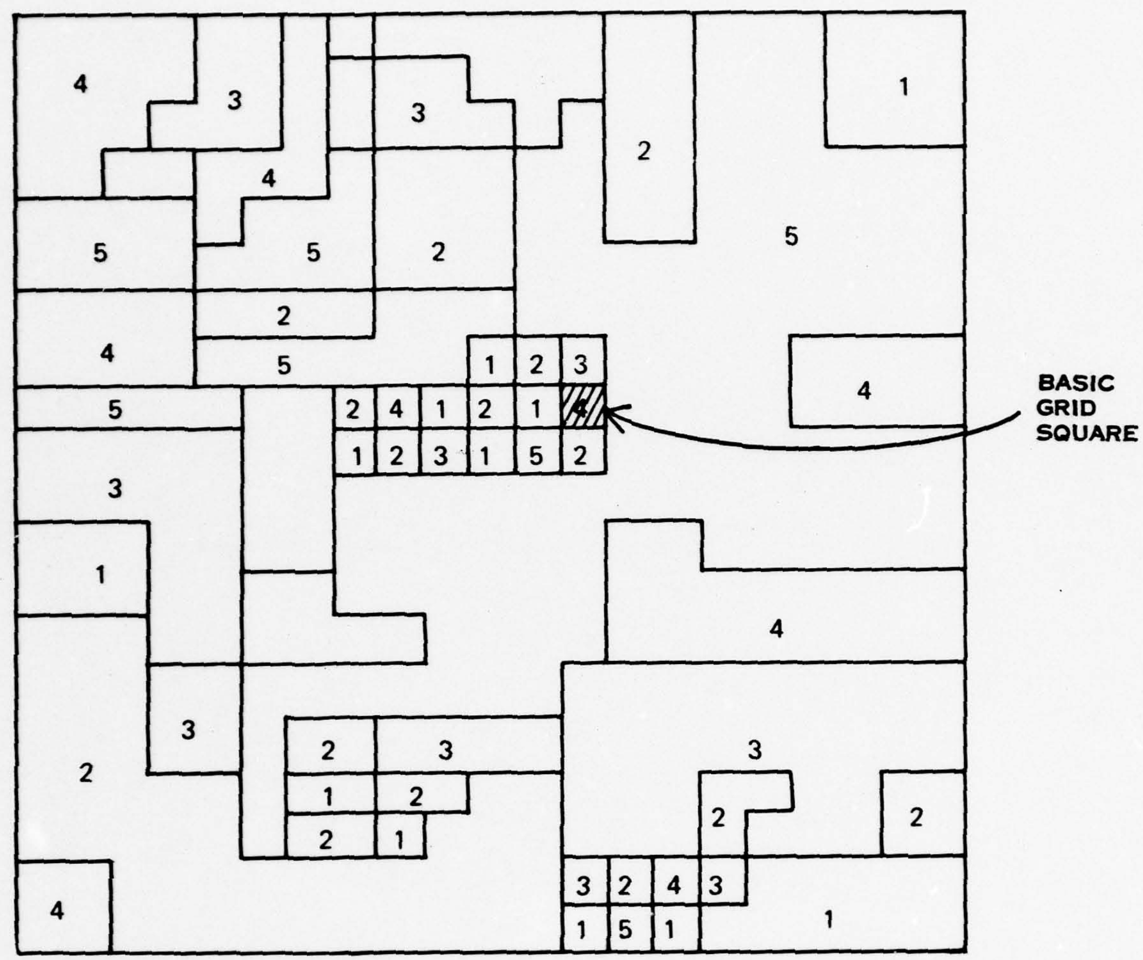

Figure 5.2-2. Overlay Grid EValuation

SLOPE = BASIC MOBILITY OVERLAY FOR CROSS COUNTRY MOVEMENT

- 5 GRADATIONS OF MOBILITY (NUMBER OF BATTALIONS PER HOUR PER KM)
  - STOPPED (NO PASSAGE)
  - VERY SLOW (MOVEMENT ONLY WITH UNUSUAL ENGINEER SUPPORT)
  - SLOW (MOVEMENT SLOWER THAN DISMOUNTED INFANTRY)
  - INHIBITED (CONSIDERABLY LESS THAN DOCTRINAL ADVANCE RATE)
  - GO (DOCTRINAL ADVANCE RATE OR GREATER)
- VARIATIONS - NONE

VEGETATION = DEGRADATION FACTOR (D_{VEG}) FROM BASIC SLOPE OVERLAY PRESENTED AS DEGRADATION FROM 100% FOR NO VEGETATION

- D_{VEG} = FUNCTION OF (TYPE OF VEGETATION, DENSITY, TIME OF YEAR)
- 5 GRADATIONS OF MOBILITY (% OF DEGRADATION) SAME FIVE MOBILITY CATEGORIES AS SLOPE
- VARIATIONS - TIME OF YEAR

SURFACE/SOIL = DEGRADATION FACTOR ($D_{S/S}$) FROM BASIC SLOPE OVERLAY PRESENTED AS DEGRADATION FROM 100% FOR HARD/DRY SURFACE

- $D_{S/S}$ = FUNCTION OF (TYPE OF SOIL, RAINFALL, TEMPERATURE, TIME OF YEAR)
- 5 GRADATIONS OF MOBILITY (% OF DEGRADATION) SAME FIVE MOBILITY CATEGORIES AS SLOPE
- VARIATIONS - PRECIPITATION, TEMPERATURE

WETLANDS = DEGRADATION FACTOR (D_{WET}) FROM BASIC SLOPE OVERLAY PRESENTED AS DEGRADATION FROM 100% FOR HARD/DRY SURFACE

- D_{WET} = FUNCTION OF (TYPE OF WETLAND, PRECIPITATION, TIME OF YEAR)
- 5 GRADATIONS OF MOBILITY (% OF DEGRADATION) SAME FIVE MOBILITY CATEGORIES AS SLOPE
- VARIATIONS - PRECIPITATION, TIME OF YEAR

Figure 5.2-3. Factor Overlay Characteristics

5.3 DATA REQUIREMENTS FOR AUTOMATED IPB TERRAIN OVERLAYS

In order to develop the individual factor overlays and the resultant combined obstacle overlays it is necessary to classify each of the basic terrain areas in one of the five mobility categories. These categories each have a military significance but must be developed from basic terrain data. A key factor in the development and definition of these terrain overlays is to reduce the basic input terrain data requirements to a minimum. Otherwise the entire IPB process will become too cumbersome and costly to ever be a significant military factor.

To evaluate the effect of terrain on ground force mobility the Soviet T-72 tank was used as a basic gauge. Since modern armies are highly mechanized the mobility of large ground forces will be determined mainly by the mobility of its armor. The main elements of this armor are the medium tank and the armored personnel carrier (BMP). The mobility characteristics for most terrain considerations are similar for both the T-72 tank and the BMP armored personnel carrier, making the T-72 a reasonable choice as the basic gauge. For road and bridge traffic consideration is also given to the differences in tracked vehicles and the large number of wheeled vehicles in a modern division.

The definition of the "GO" category is that the military ground force can maintain the nominal doctrinal rate of advance. To do this it is assumed that the armored fighting vehicles must be able to achieve a nominal cruising speed of 40 KPH. This does not mean that these vehicles are constantly moving at these rates but that the terrain will permit this speed when required. An alternate definition of the GO category therefore, is terrain that will support nominal speed of 40 KPH for the T-72 tank.

The INHIBITED category is defined as one half of the doctrinal rate of advance. In a straight extrapolation this is equated to terrain that will support a nominal speed of 20 KPH for armored fighting vehicles. The SLOW category is tied to the doctrinal rate of advance of dismounted infantry. This is approximately 1/6 of that of motorized forces and therefore a nominal rate of 7 KPH for armored vehicles is used for this category. For the VERY SLOW category (defined as requiring "unusual engineer support") a pontoon bridging operation was used as a basic gauge. This includes the time to assemble the bridge, concentrate forces for crossing, and disperse back into doctrinal formations. For the case chosen this is equivalent to 0.2 battalions per hour per kilometer of front, a nominal rate of less than 1/10 of the doctrinal rate. The equivalent value for the nominal speed of armored fighting vehicles is 3 KPH.

Each of the five categories of mobility is defined in Figure 5.3-1 in terms of throughput, i.e., number of battalions per hour per kilometer, or the corresponding speed for armored fighting vehicles the terrain will support. These are nominal values, representing the medium of the category. To determine the range of throughputs for each category and therefore the mobility thresholds between categories, the geometric mean between categories was utilized. For example, the nominal value for the GO category is 2.7 battalions per hour per kilometer, while that of the INHIBITED is 1.4 battalions per hour per kilometer. The geometric mean of 2.0 battalions per hour per kilometer is therefore used as the boundary between categories.

For the speed of the armored fighting vehicles the boundary between GO and INHIBITED is 30 KPH. Figure 5.3-1 summarizes the mobility categories and their nominal and boundary values for both the throughput rates and the speed of armored fighting vehicles. These rates will apply only to cross-country movement. Road traffic mobility will be discussed further in Section 5.3.2.

MOBILITY CATEGORY	NOMINAL VALUE		CATEGORY BOUNDARIES	
	Bn's/Hr/Km	KPH (Tank)	Bn's/Hr/Km	KPH (Tank)
GO	2.7	40	> 2.0	> 30
INHIBITED	1.4	20	< 2.0 > 1.0	< 30 > 15
SLOW	0.6	7	< 1.0 > 0.3	< 15 > 5
VERY SLOW	0.2	3	< 0.3 > 0.1	< 5 > 1.5
STOP	0	0	< 0.1	< 1.5

Figure 5.3-1 Mobility Category Ratings and Boundaries (Cross Country)

5.3.1 Cross-Country Mobility Factor Overlays

To develop the mobility ratings for each of the cross-country overlays it is necessary to determine how each terrain factor (slope, soil, vegetation, etc.) will affect the mobility of the T-72 tank. Fortunately, the U.S. Army's Engineering Topographic Laboratory/ Terrain Analysis Center (TAC/ETL) has performed such an analysis (in preliminary form). During the course of this analysis it was only necessary to convert the data that TAC/ETL developed into the five categories of mobility used for IPB.

Slope

Figure 5.3-2 shows a plot of the performance of the T-72 tank where only slope is considered as a terrain factor. To determine the boundaries for the five mobility categories the threshold values in terms of armored fighting vehicle speed are applied from the data in Figure 5.3-1 as indicated by the dashed lines. Each of these speed values corresponds to a specific slope value which may then be used to describe the mobility category. For example, when considering slope alone, any areas of slope between 0% and 20% will be considered as "GO". Other slope determinants are as indicated in Figure 5.3-2.

Vegetation

During their analysis the ETL/TAC had identified 46 types of vegetation that could have potential effects on mobility. These were divided into twelve major categories such as: Cropland (Type A), Grassland (Type B), Coniferous Forest (Type C), and Deciduous Forest (Type D). The Coniferous, Decidous, and Mixed (Types C, D, and E) are further subdivided into twelve types in accordance with their stem spacing and diameter. Each of the types of vegetation have a nominal

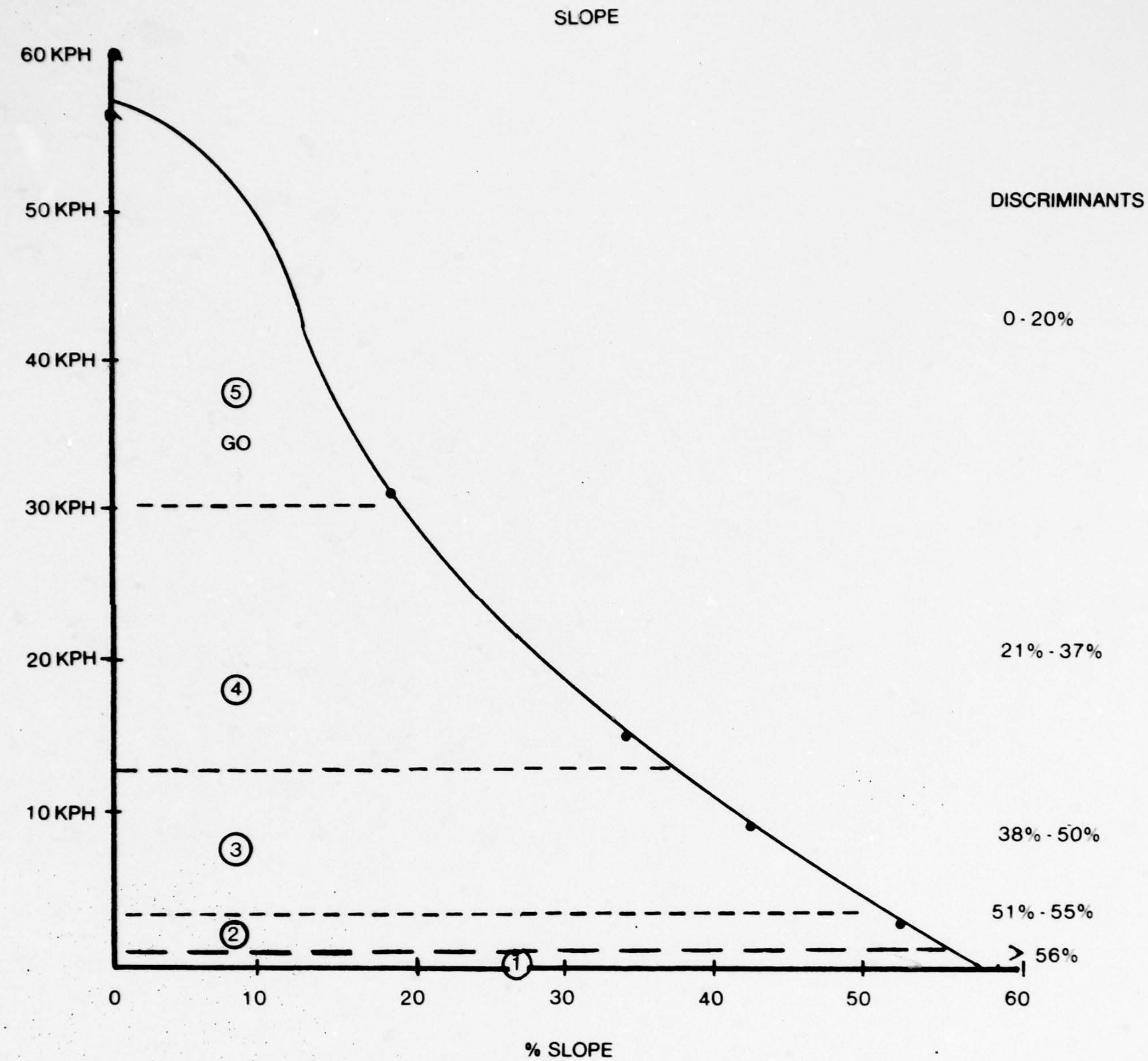

Figure 5.3-2. Effects of Slope on Mobility

degradation effect on the mobility of the T-72 tank. Figure 5.3-3 illustrates this effect for each type, starting with those that have no effect (mobility is equal to 1.0) and continuing to those for which mobility is zero. Assuming a top speed of 58 KPH, the mobility categories may again be defined for the effects of vegetation only. It should be noted that in using this approach seven of the twelve major categories fall entirely within the "GO" range and 28 of the 46 types fall in the "GO" range. The "GO" category may then be differentiated as any vegetation type that is not Marshes (Type J) or Peat Cuttings (Type M) and any Coniferous, Deciduous, or Mixed forest whose average height is greater than 5 meters but for which canopy closure is less than 50 percent. Height and canopy closure are used as discriminants since these are directly related to stem diameter and spacing yet are more readily measured. Figure 5.3-4 indicates the other differentiations of mobility categories required for IPB terrain overlays.

Soils

The ETL/TAC analysis identified 16 different soil types for consideration. Figure 5.3-5 indicates the effect of each of the soils on the speed of the T-72 tank. For dry conditions, all but three of these soil types; organic (type 15), organic salts (type 11), and fat organic clays (type 14) fall in the GO category. Under soil saturation conditions only lean clays (type 10, or organic silts (type 11) change mobility categories. The result of this analysis indicates that for dry conditions only organic base soils will affect mobility, and for wet conditions clays will also have an appreciable effect. The basic data required for developing the IPB soil factor overlay, therefore, requires only the identification of clay and organic soils.

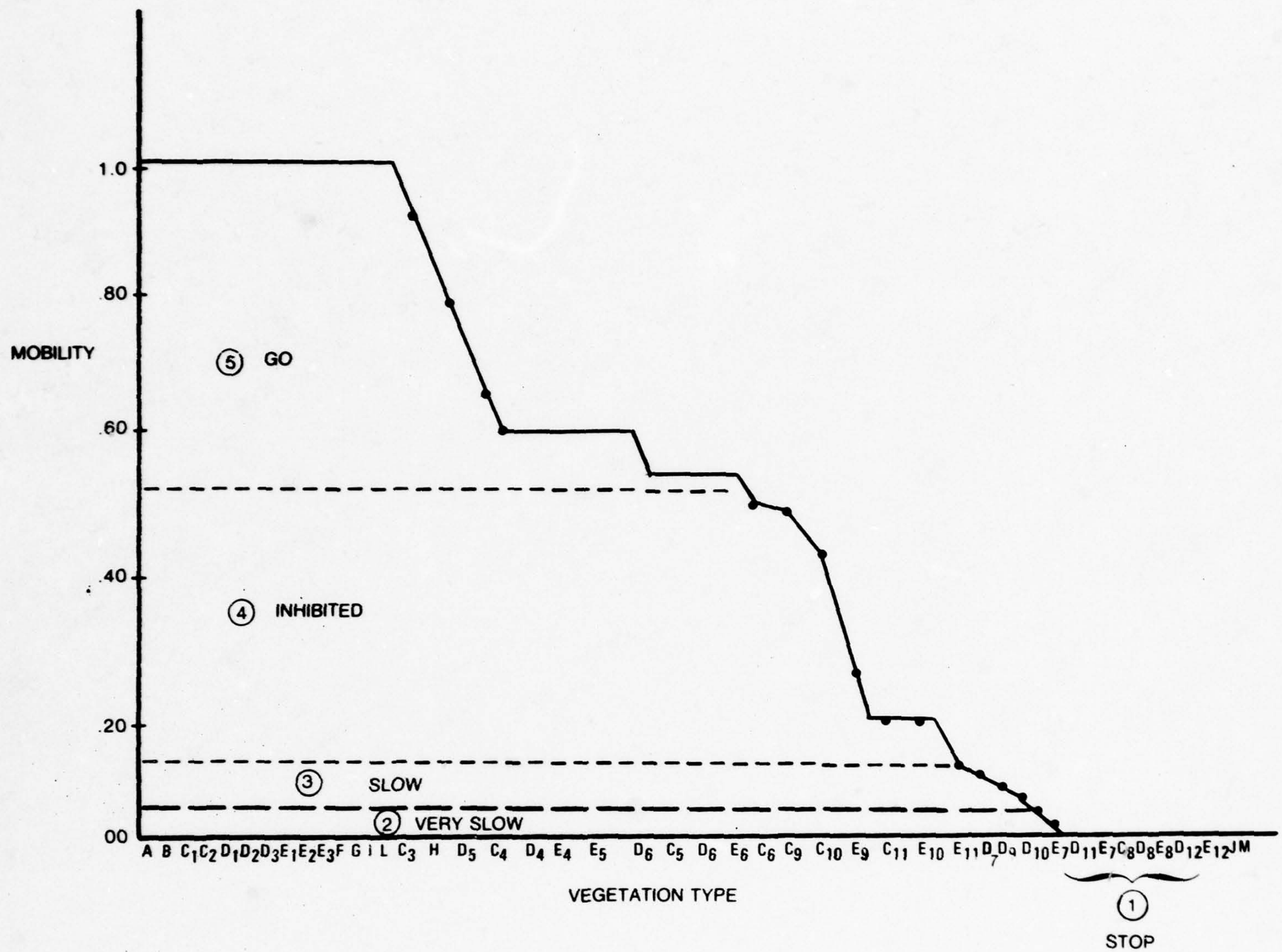

Figure 5.3-3. Effects of Vegetation on Mobility

CATEGORY	TYPE VEGETATION	DIFFERENTIATION BETWEEN CATEGORIES	ACTUAL DATA REQUIRED
GO	A, B, F, G, I, L, H C_1 THRU C_6 D_1 THRU D_6 E_1 THRU E_6	CONE CONTENT; HEIGHT ≤5 IN. DECIDUOUS; HEIGHT ≤20 m; CLOSURE >50%	TYPE / HEIGHT / CLOSURE DECIDUOUS ≤ 5m >50% CONIFEROUS MIXED ≤ 20m >75% PEAT/SWAMP
INHIBITED	C_9 THRU C_{11} D_7 E_9, E_{10}	DECIDUOUS; HEIGHT ≤5 MIXED; HEIGHT ≤20; CLOSURE >50%	
SLOW	D_9, D_{10} E_7, E_{11}	CONIFEROUS; HEIGHT ≤5 m, CLLOSURE ≥75% DECIDUOUS; HEIGHT ≤5 m, CLOSURE ≥50%	
VERY SLOW	C_{12} D_{11}	CONIFEROUS; 5m ≤HEIGHT ≤20m, CLOSURE >50% DECIDUOUS CONTENT, HEIGHT ≤20; CLOSURE >75% SWAMP OR PEAT CUTTINGS	
STOP	C_7, C_8 D_8, D_{12} E_8, E_{12} J, M		

Figure 5.3-4. Differentiators for Vegetation Mobility Categories

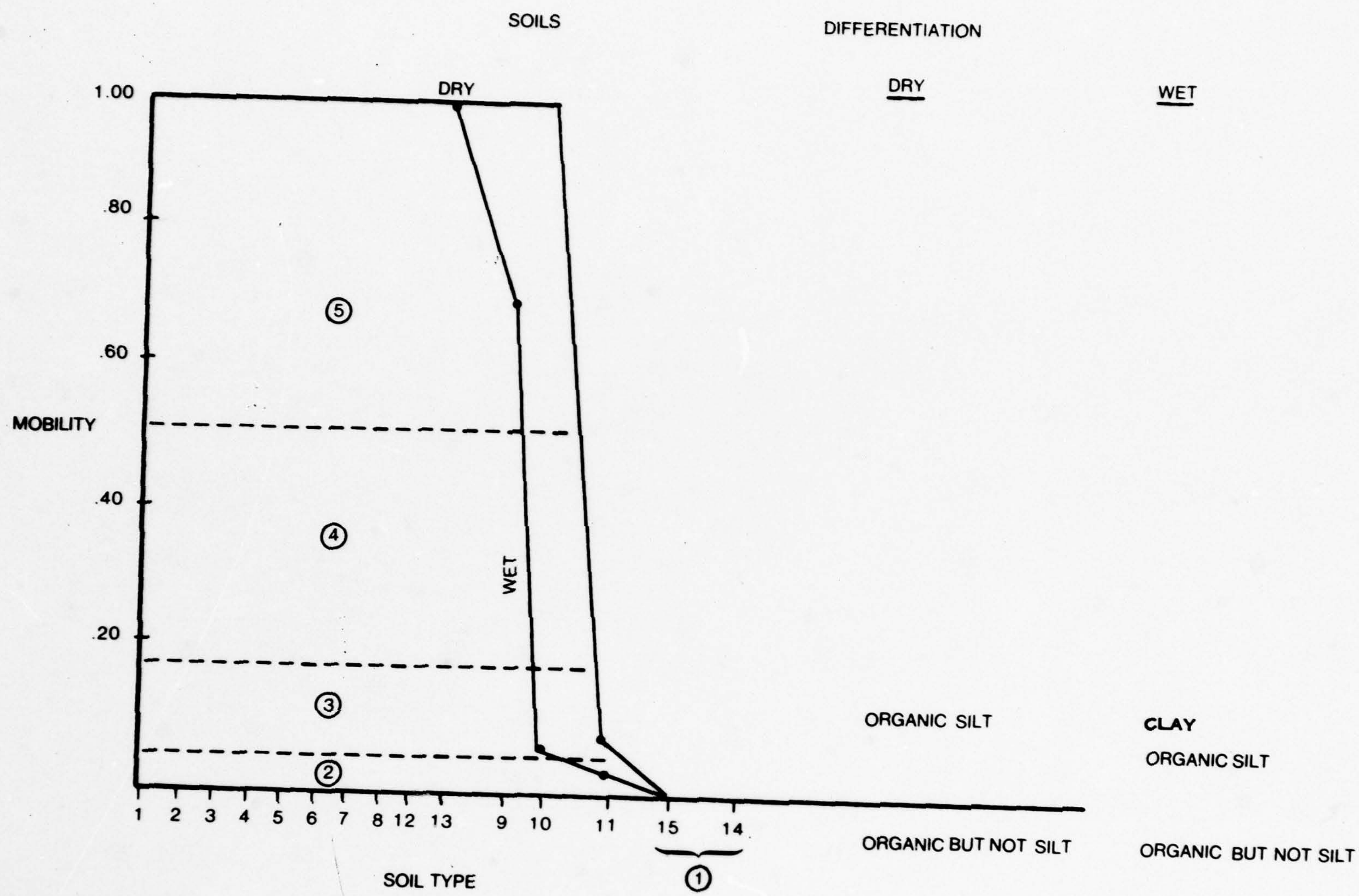

Figure 5.3-5. The Effect of Soil on Mobility

Wetlands

The wetlands overlay includes the effects of streams, rivers, lakes, and swamps on cross-country movement. The wetland is presented on the overlay in a manner which indicates the mobility that a ground force can maintain while having to traverse the obstacle. This includes concentration for approach, crossing, and dispersal into combat functions. Swamps are considered as STOP areas. All the other wetland types are evaluated in terms of their potential to be traversed by fording, bridging, or ferry. These in turn are dependent on width, depth, current, and in some cases the nature of the bottom of the wetland area. In order to generally categorize wetland areas an analysis has been made of fording, bridging, and ferry operations to determine the terrain parameters that will influence wetland mobility.

Figure 5.3-6 indicates the analyses for fording options. This is based on an amphibious fording (limited to motorized rifle battalions) and shallow or deep wade fording. For the conditions of current, depth, and bottom required a plot is made of the speed of the armored fighting vehicle versus the river depth. This indicates that if fording is possible at all it will fall in the SLOW category.

Figure 5.3-7 indicates the analysis for bridging options. This is based on either the use of mobile scissors bridging (1 per regiment) or pontoon bridging (1 per division). The analysis was performed allowing for the bridging to reach the river and be installed as well as the time to concentrate and cross. The figure indicates the net effect on mobility as a function of the time to reach the river and install the bridge. It is assumed for rivers less than 40 meters that the scissors bridge will be used since that is its maximum capability. For pontoon bridging the net effect of bridging on mobility is also a function of the river width since this affects construction time.

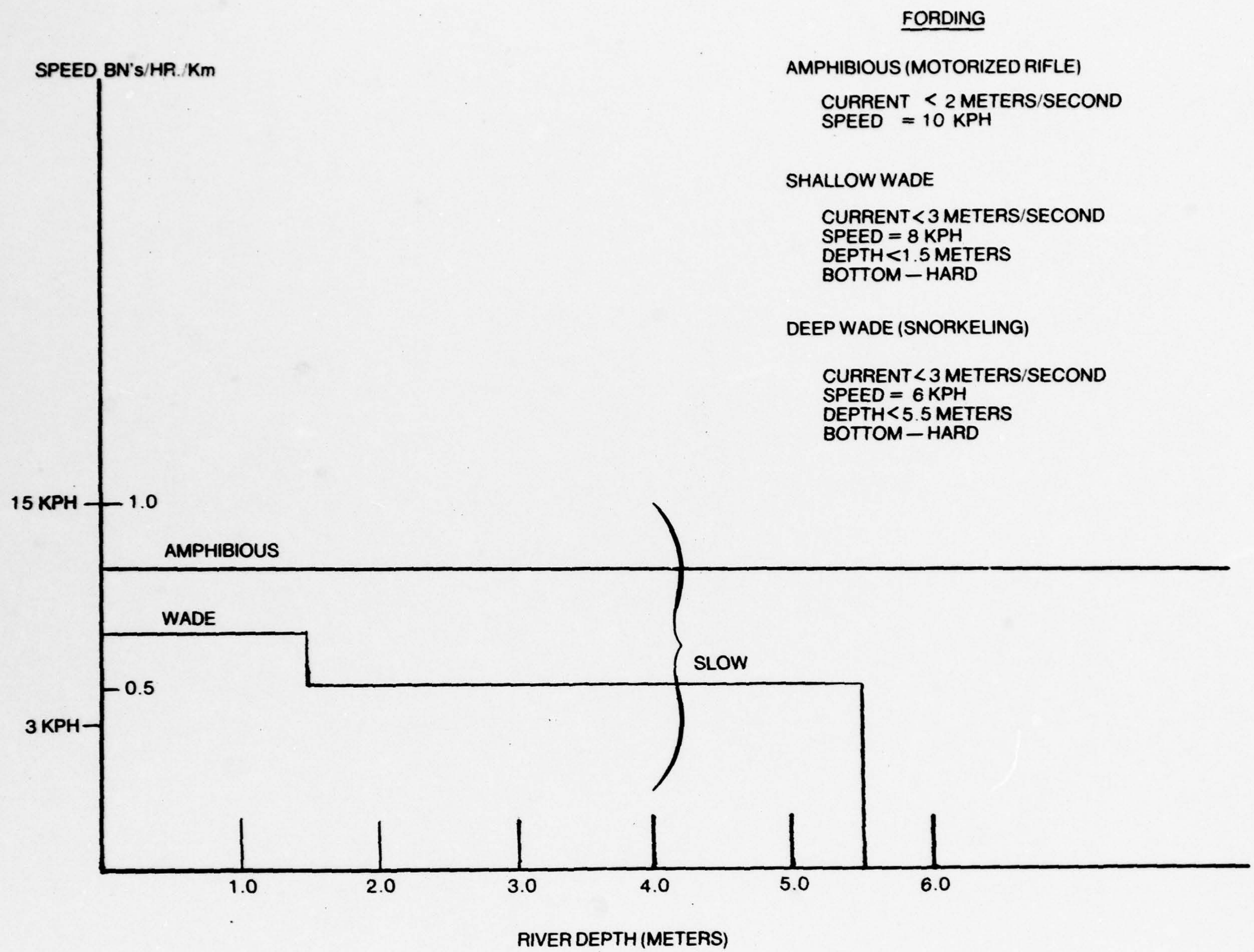

Figure 5.3-6. Effects of Fording on Mobility

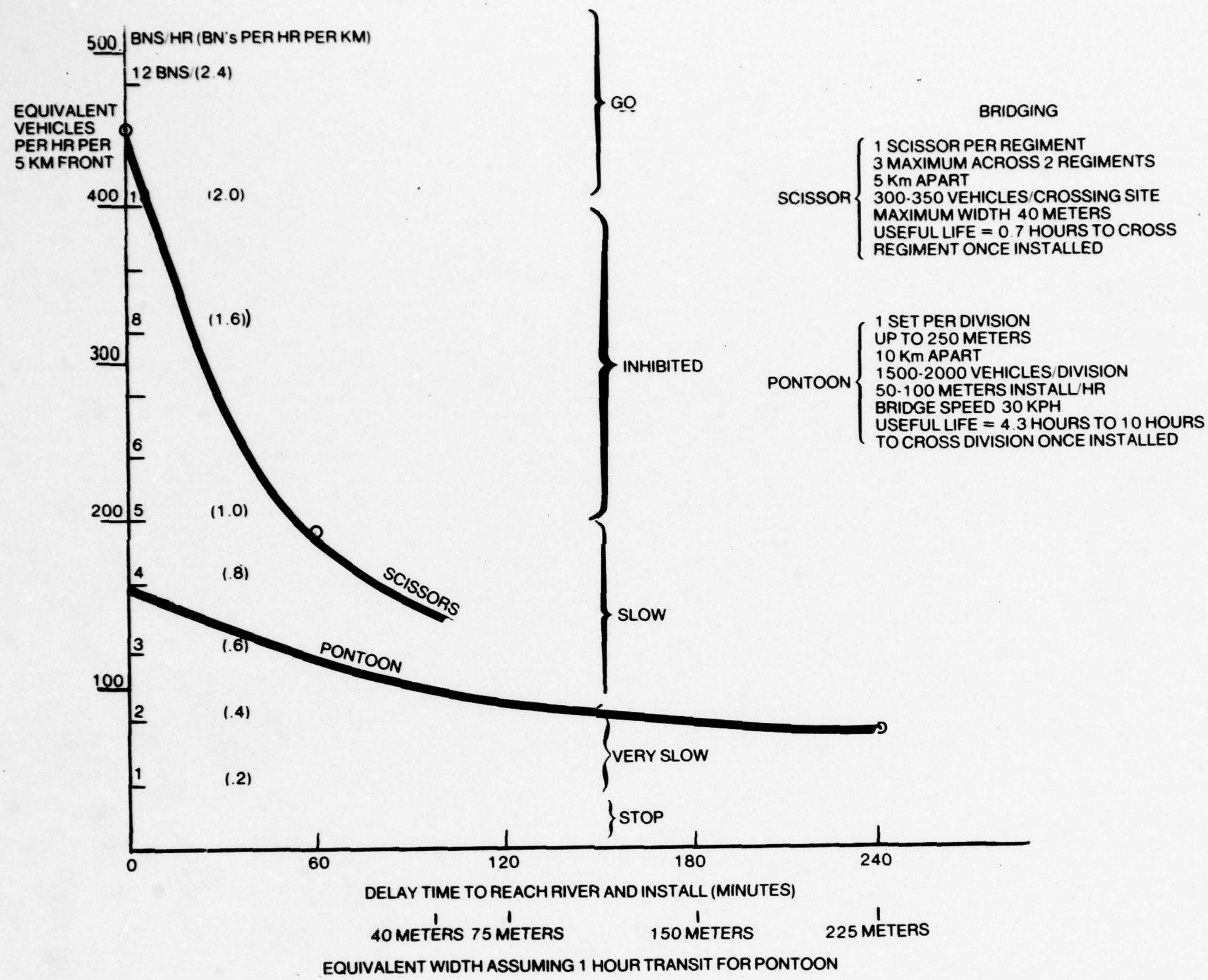

Figure 5.3-7. Effects of Bridging on Mobility

As in the example indicated in Figure 5.3-7, if a one-hour transit is assumed for bringing up the pontoon material then that effect on mobility can be expressed in terms of the river width. It is again important to note that for reasonable delay times (1-3 hours) in bringing up the bridging equipment, bridging for widths less than 40 meters will fall in the SLOW category and that greater than 40 will fall in the VERY SLOW category, up to the maximum of 250 meters.

Figure 5.3-8 indicates the analysis for wetlands that must be traversed by ferrying operations. There are many variables in such an analysis, the most critical of which is the setup, load and unload times for vehicles. For this analysis two-minute load/unload times were used and a two hour set up time. It is further assumed that ferry operations will only be used where bridging is not feasible and at widths greater than 200 meters. The analysis indicates that ferry operations fall in the VERY SLOW category unless the width of the wetland exceeds 1,000 meters in which case it would cease to be a viable option for a large force.

The critical terrain factors, therefore, in determining mobility across wetland areas are the width, depth, current, and in some cases the condition of the bottom. In all cases the wetlands will fall in the SLOW category or below unless the width is less than 6 meters and the depth less than 1.5 meters in which case armored fighting vehicles can ford without difficulty and concentration at crossing points is not required. So long as the wetland is no greater than 40 meters in width the mobility will be no less than SLOW and so long as it is no greater than 1,000 meters in width the mobility will be no less than VERY SLOW. Therefore, it is possible to reduce the wetlands terrain considerations to the width and the question of whether the depth is less than 1.5 meters.

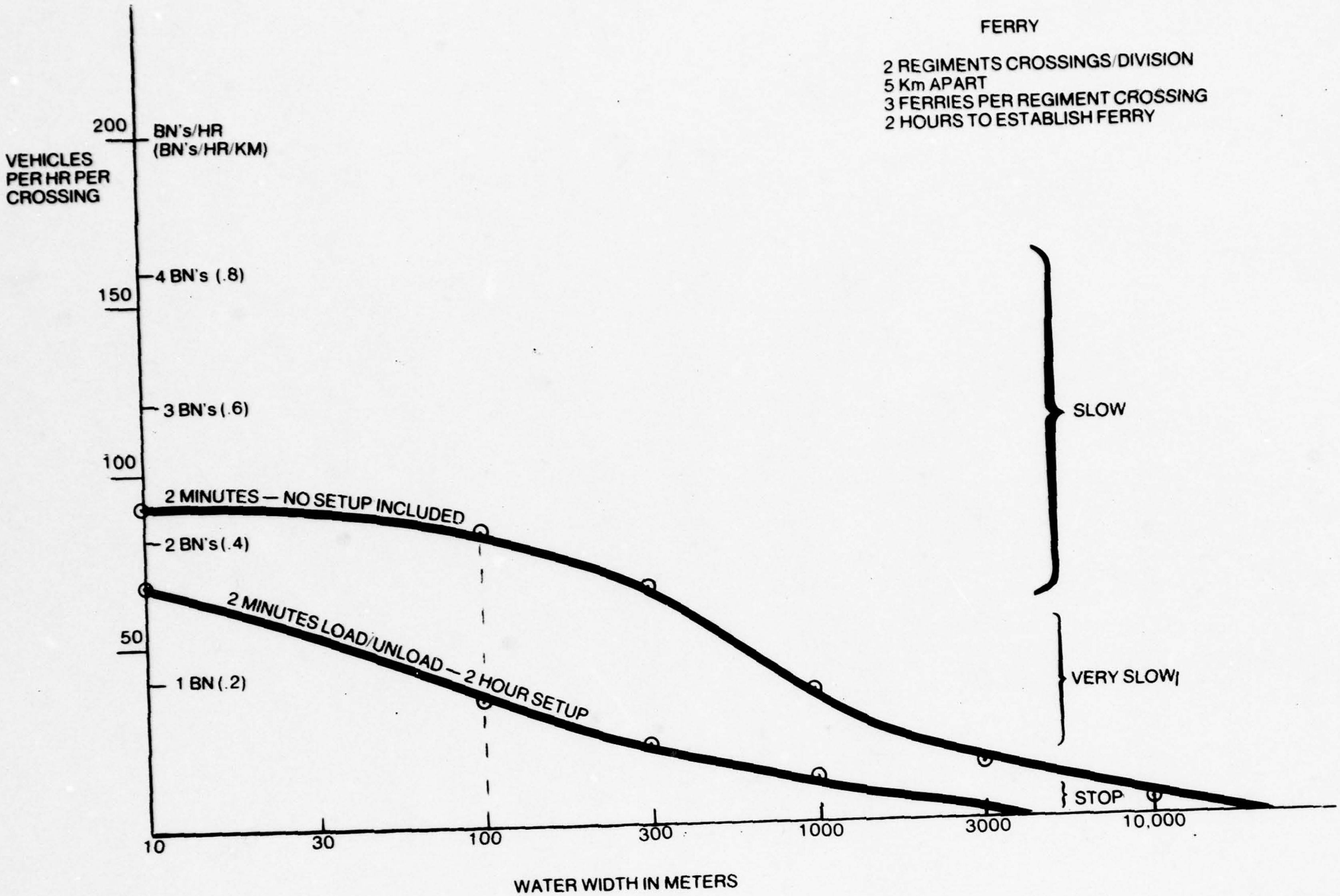

Figure 5.3-8. Effects of Ferrying on Mobility

It should be noted that considerations for approaches to river crossings are included in the slope and soils overlays. It should also be noted that the simplification of data required for the wetlands is due to the fact that the concern for this application is only with the mobility for large units over relatively large areas of terrain. The method an enemy would use for overcoming the obstacle and exact crossing or bridging points are not of concern, only the overall mobility impact. For instance, the SLOW category encompasses fording and scissor bridging. The factors that an enemy would evaluate in choice of method or placement are not important for the overlay determination. Whatever choice that is made the result is SLOW so long as the width does not exceed the capabilities of (40 meters) the scissors bridge.

A summary of the cross-country mobility categories, category boundaries, and terrain data discriminants between categories is presented in Figure 5.3-9. To determine mobility category the analysis starts with the STOP category. Terrain which meets the criteria for the STOP category is assigned this category; if not the VERY SLOW category is tested. If the terrain meets the criteria for this category it is assigned unless it has already met the STOP category requirements. The analysis continues through the INHIBITED category. If the terrain was not been assigned to the first 4 categories it is assigned to the GO category.

5.3.2 Lines of Communication

The treatment of lines of communication mobility differs from cross-country in two respects. The first is that throughput is expressed in terms of battalions per hour along the line of communications rather than across a kilometer of front. The second is that mobility is not tied to armor fighting vehicles alone but

MOBILITY	CATEGORY DATA DISCRIMINANTS				
			SOILS		
CATEGORY	SLOPE	VEGETATION	DRY	WET	WETLANDS
GO	All Others	All Others	All Others	All Others	All Others
INHIBITED	≥ 21%	Cone Content; Height ≤5m OR Deciduous; Height ≤ 20m; Closure ≥50%			
SLOW	≥ 38%	Deciduous; Height ≤ 5m OR Mixed; Height ≤ 20m; Closure ≥ 50%	ORGANIC SILT	CLAY	Width > 6m OR Depth > 5.5m
VERY SLOW	≥ 51%	Coniferous; Height ≤5m; Closure ≥75% OR Deciduous, Height ≤5m; Closure ≥ 50%		ORGANIC SILT	Width > 40m AND Depth > 5.5m
STOP	≥ 56%	Coniferous; 5m ≤ Height ≤ 20m, Closure ≥ 50% OR Deciduous Content; Height ≤ 20m; Closure ≥ 75% OR SWAMP / PEAT CUTTINGS	ORGANIC BUT NOT SILT	ORGANIC BUT NOT SILT	Width > 1000m

Figure 5.3-9 Summary of Terrain Data Discriminants For Mobility Categories

includes wheel vehicle progress as well. Since lines of communications must pass support units as well as combat battalions, the time to pass a division becomes as significant a measure as battalions per hour. A differing standard of advance is also used since doctrinal advance rates along roads for mixed columns is approximately twice that for cross-country.

Using the doctrinal rate of advance of 25 KPH and the doctrinal formation of battalions traveling 5 Km apart with 50 vehicles per battalion, the nominal GO rate for a single road for which the formation and speed can be maintained is approximately 5.5 battalions per hour. For a division to pass 13-16 battalions plus 2,000 wheeled vehicles at the average rate of 35 KPH and 15-meter spacing will take approximately 4 hours for the same road. The definition of the other four categories of mobility follow as in the case of cross-country. The INHIBITED rate is nominally half the doctrinal rate, 2.8 battalions per hour or 8 hours to pass a division. The SLOW rate is nominally that rate of dismounted infantry which is 1/5 of the motorized rate or approximately 1.3 battalions per hour or 18 hours to pass a division. The VERY SLOW rate is based upon a continuous road clearing operation for mines or obstacles at the nominal rate of 0.5 battalions per hour or 48 hours to pass a division. Boundaries between mobility categories are again selected on the basis of the geometric mean between nominal values. Figure 5.3-10 summarizes the mobility categories, throughputs, and category boundaries for lines of communication.

MOBILITY CATEGORY	NOMINAL VALUE		CATEGORY BOUNDARIES	
	Bn's/Hr	Time to Pass Division	Bn's/Hr	Time to Pass Division
GO	5.5	4.0 hrs	>4.2	<6.0 hrs
INHIBITED	2.8	8.0 hrs	<4.2 >2.1	>6.0 hrs < 12 hrs
SLOW	1.3	18 hrs	<2.1 >0.9	>12 hrs <32 hrs
VERY SLOW	0.5	48 hrs	< 0.9 >.25	>32 hrs <72 hrs
STOP	0	—	<.25	>72 hrs

Figure 5.3-10 Mobility Category Ratings and Boundaries (Lines of Communication)

Roads

Roads are the primary factor overlay for lines of communication. Basic map data provides indications of four road categories. These are:

4/6 Lane Highways
Main Road (6m or more)
Secondary Road (5-7m)
Connecting Roads (4-6m)

Data is also provided on whether the road is hard surfaced, or unimproved. For use in the IPB lines of communication overlay, these road categories must be associated with one of the mobility categories.

The evaluation of a roadway is based upon its ability to support the doctrinal rate of advance for mixed or wheeled traffic in the doctrinal formation and spacing. The hard surface primary road of 6.0 meters or greater will support a single column advance at this rate and formation for either mixed or wheeled traffic. It therefore is the standard gauge for GO mobility. A secondary road of 5-7 meters is capable of supporting armored fighting vehicles alone in the doctrinal formation at the GO rate, however, time to pass a division of mixed traffic is considerably degraded by surface destruction and choke points caused by turn radii, overpasses, etc. The effect is to increase the time to pass a division to 6.0 hours with a mixed column advance of between 15 and 20 kilometers per hour. Connecting roads are not only restricted by their width but also by an average capacity figure of 4,950 tons forward or 990 vehicles per day. They are capable of supporting up to three battalions or 990 vehicles per day. If used by combat battalions connecting roads will be limited to the one time use of 3 battalions. They may be used alternatively to pass approximately one-half of a division's wheeled vehicles forward in 24 hours. A connecting road therefore will be considered SLOW for up to 3 battalions and STOP for any force of regimental size or greater.

It should be noted however, that two parallel connecting roads will support a single regiment at SLOW.

Four or six lane highways are capable of supporting the equivalent of 2 columns of mixed vehicles at the doctrinal rate of advance and with doctrinal spacings. This equates to over 10 battalions per hour or 2.0 hours to pass a division. This is a special mobility category for lines of communications which is defined as GO PLUS.

The mobility categories, their equivalent throughputs, and times to pass a division for each road type are given in Figure 5.3-11.

Bridges

Bridges are often the mobility limiting factor for roadways since they can represent choke points due to weight limitations or reductions in road width or road shoulder. The weight limitations are binary, they do or do not cause a STOP condition. This is dependent on the unit type under consideration. Tank battalions will require bridges of at least 40 tons while motorized rifle battalions will require bridges of up to 14 tons. The impact of load bearing weight can only be to cause a STOP condition. If the bridge will support the armor then the mobility consideration will be determined by width and other constrictions.

Normally the bridge will only change the mobility category of the line of communication if it is narrower than the roadway. The percentage degradation in mobility depends upon the bridge width and the type of roadway. When developing the lines of communications overlay the mobility rating of the road is degraded by the percentage indicated in Figure 5.3-12. Bridge weight restrictions must be indicated by accompanying tabular restrictions by vehicle type.

TYPE	BATTALIONS PER HOUR	TIME TO PASS A DIVISION
Highway (4 Lane)	10	2.1 Hours
Primary Road (Main)	5.5	4.0 Hours
Secondary Road	5.5	6.0 Hours
Connecting Roads	2 But only maximum of 3 Battalions total	Unusable (> days)

DATA

- Battalions travel 5 Km apart in columns with 50 vehicles per battalion at 25 KPH (10 vehicles per kilometer average)
- Division must pass 14-16 battalions at rate above plus 2,000 additional wheeled vehicles at 35 KPH with 15 meter spacing
- 4 lane highway allows the equivalent of two columns to maintain vehicle separation
- Secondary roads limit mixed traffic to rate of 15 to 20 KPH
- Connecting roads will support 990 vehicles per day or 4,950 tons per day which = 3 tank battalions or 990 other vehicles based on 15-hour day
- Escarpments greater than 500 meters in length indicated as linear STOP areas adjacent to roads

Figure 5.3-11. Effect of Roads on Mobility

BRIDGE WIDTH	4 LANE	PRIMARY	SECONDARY	CONNECTING	APPROACH
>16 Meters	100%	100%	100%	100%	Degrade Road Capacity By % to Get Bridge Capacity
<16 Meters >12 Meters	75%	80%	100%	100%	
< 12 Meters > 8 Meters	50%	75%	100%	100%	
< 8 Meters > 4 Meters	25%	40%	50%	100%	List All Weight Restrictions by Vehicle Type Limitations Tank, BMP, Wheeled, etc.
< 4 Meters	0%	0%	0%	0%	

Figure 5.3-12. Effects of Bridges on Mobility

5.4 THE DEVELOPMENT OF MOBILITY CORRIDORS

The combined obstacle overlay presents the characterization of cross-country terrain and lines of communication in terms of the five categories of mobility. The result is a multicolored overlay as shown in Figure 5.4-1 with each color conveying relative mobility of military ground forces across the terrain. The goal of an IPB terrain analysis is to identify potential favorable corridors of movement for enemy forces from this basic terrain presentation. The mobility corridor overlay is therefore a simplification of the combined obstacles overlay which highlights the best routes of enemy mobility across the terrain in question. However, mobility corridors can only be established for a particular force size. For example, a GO corridor for a regiment may be SLOW for a division, and VERY SLOW for an army.

The mobility corridor analyst then maps out the best corridors through a region and identifies the mobility category for an echelon, e.g., regiment. This process is initiated by assuming a start point and an objective end point for the enemy force. Alternate routes are then traced manually across the combined obstacle overlay, traversing only GO and INHIBITED areas, and SLOW areas if there is an advantage to doing so. For each route identified a choke point is identified as shown in Figure 5.4-2. The width of the choke point is measured and multiplied by the throughput for that area of terrain. The result will be the number of battalions per hour that can pass the choke point. In the example shown in Figure 5.4-3, the number of battalions per hour is 2.8. At the doctrinal rate of advance the equivalent pass rate for a regiment is 7 to 8 battalions per hour, meaning the entire regiment should pass in approximately one-half hour. 2.8 battalions per hour represents approximately 35% of the doctrinal rate for a regiment and falls within the SLOW category. Therefore, the entire corridor will be indicated as SLOW for a regiment. Several alternatives are evaluated

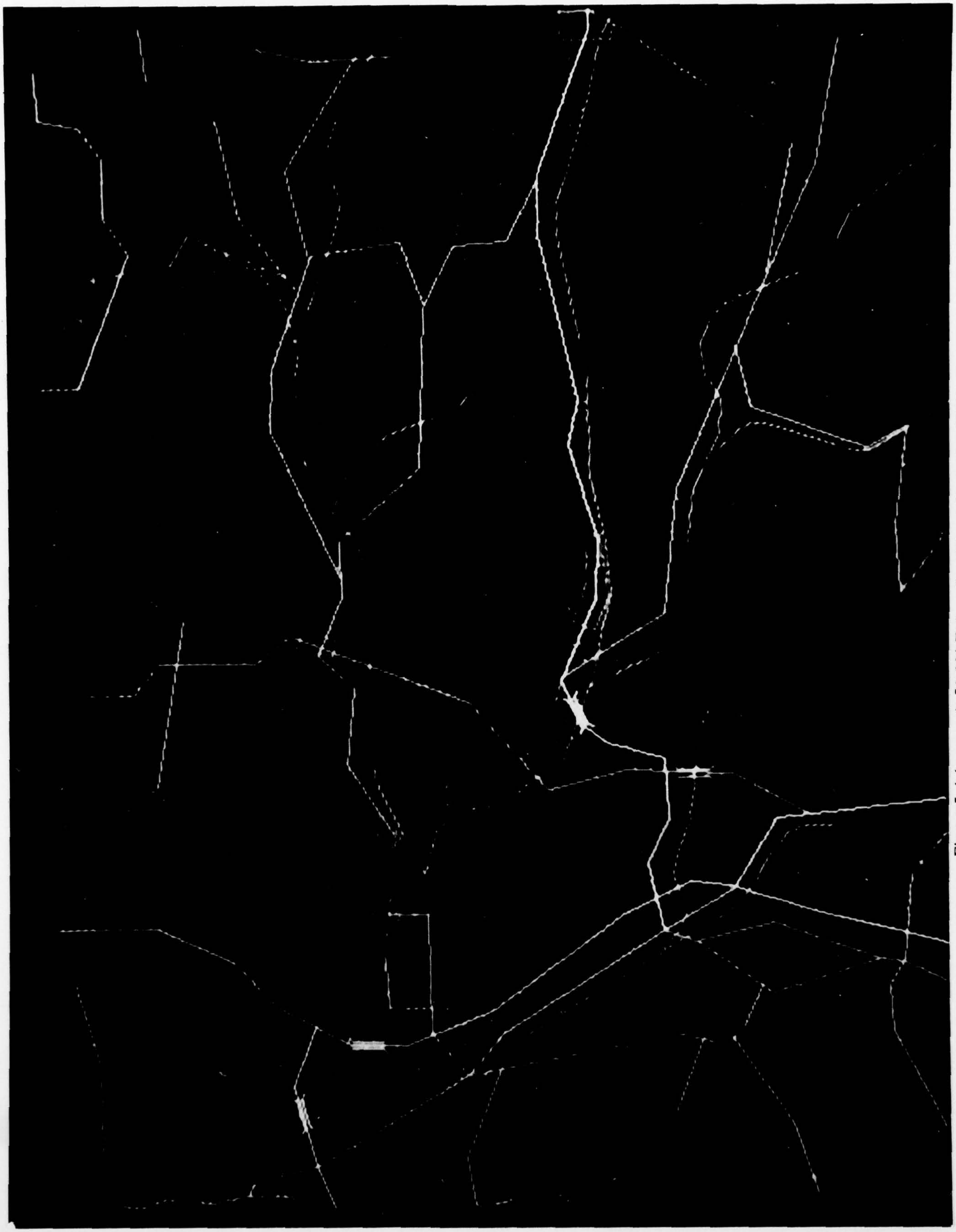

Figure 5.4-1 — 1:50,000 Folger Combined Obstacles (HJD)

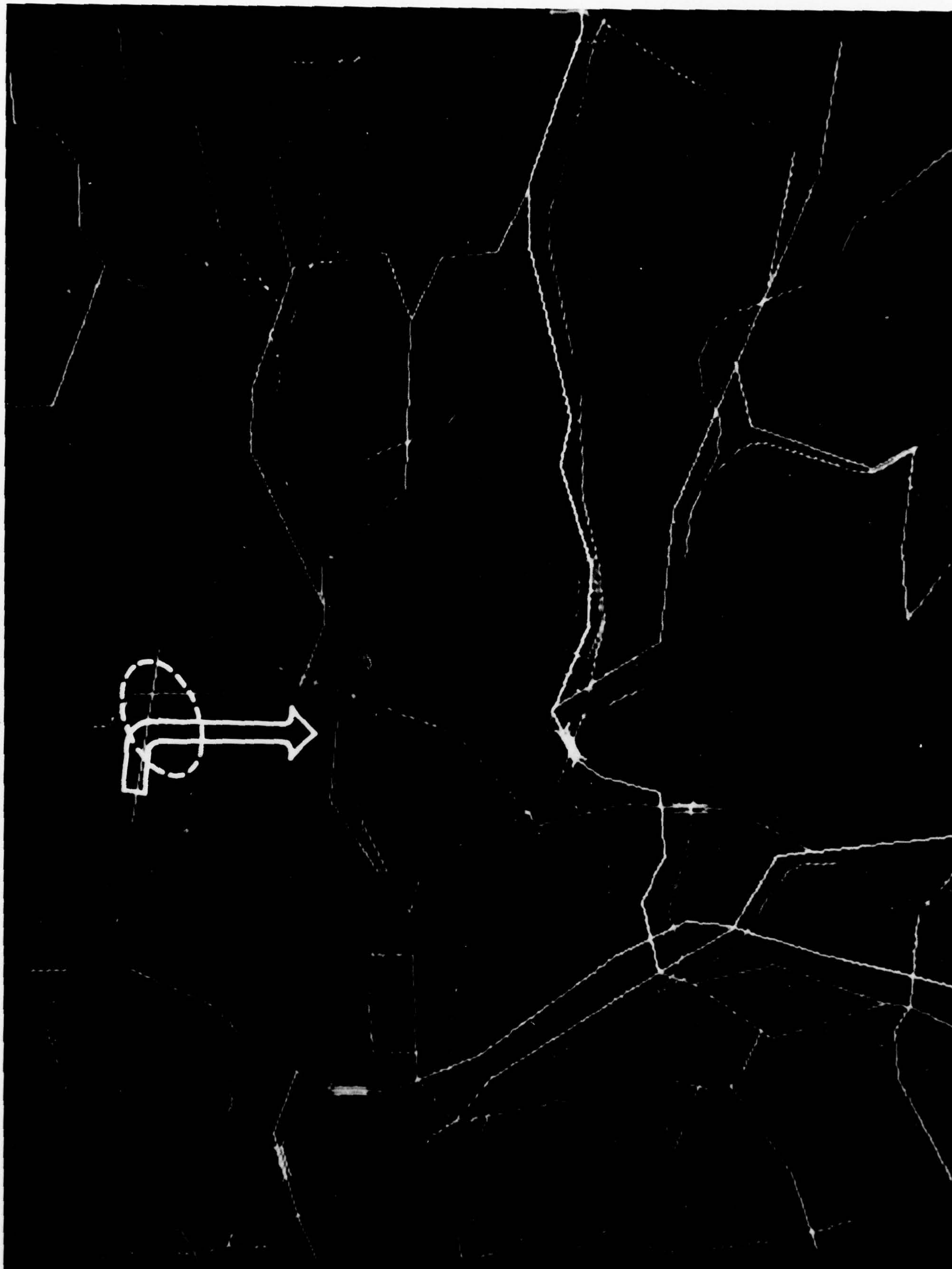

Figure 5.4-2 Typical Mobility Evaluation

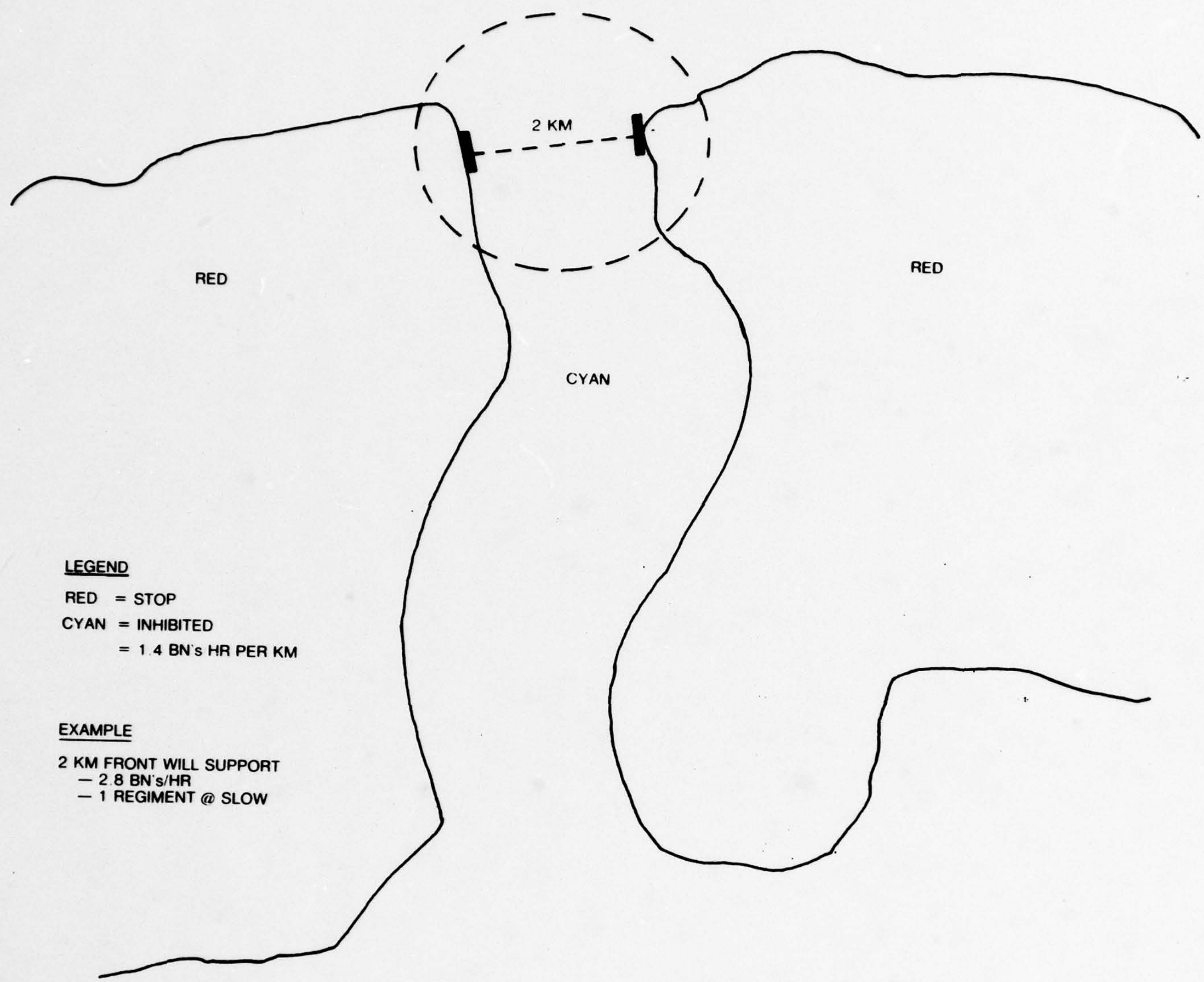

Figure 5.4-3. Mobility Corridor for a Regiment

and the two or three highest mobility corridors are selected for the overlay. Where there are small critical areas of VERY SLOW these are also considered as possibilities if opening these areas through unusual engineering efforts would significantly alter the corridor picture. The net result of the mobility corridor overlay is to portray each of the more favorable corridors in terms of the rate of advance a fixed size force can nominally achieve in the corridor.

The mobility corridor can also be modified to reflect the same information when logical friendly obstacle or barrier plans are initiated. These are preplanned mine fields, obstacles, blocking positions, etc., that can dramatically change the mobility corridor picture. For each mobility corridor overlay there will be a modified overlay which will reflect the mobility corridor picture when a preplanned friendly obstacle or barrier plan is applied. The modified mobility corridor normally will reflect a reduction in the number of corridors or the mobility rating within a corridor.

SECTION 6. DEVELOPMENT OF AUTOMATED TERRAIN OVERLAYS FOR EXPERIMENTATION

A significant part of Phase A of the TIAX Program was devoted to the development of automated displays of terrain overlays incorporating the design concepts described in previous sections. The displays were developed utilizing IBM's Tactical Systems Demonstration Facility (TSDF) at Gaithersburg, Maryland. This section will describe the capabilities of the TSDF, and how the terrain data was converted and digitized for demonstration purposes.

6.1 TACTICAL SYSTEMS DEMONSTRATION FACILITY (TSDF)

IBM's Tactical Systems Demonstration Facility (TSDF) is comprised of general purpose hardware and software installed in a physical layout designed to simulate an S-280 shelter in an Army fielded Tactical Operations Center (TOC). Figure 6.1-1 shows the physical facility with the three display terminals in the main viewing area.

Although remotely located, an IBM System 370/168 is an integral part of the TSDF capability. It operates in time-shared mode to support the Color Graphics Display System (two of the terminals in the display shelter), as well as other ADP activities throughout the facility. In addition to comprehensive software development support, the 370 also provides extensive information handling capabilities in the form of the NIPS (NMCS Information Processing System) data base management system. NIPS offers a broad range of DBMS capabilities including an ability to rapidly develop applications tailored to military command/control and intelligence systems. Comprehensive sets of graphics software reside in both the 1130 and 370, enabling experimentation with graphic displays on either system. The TSDF was basically established during

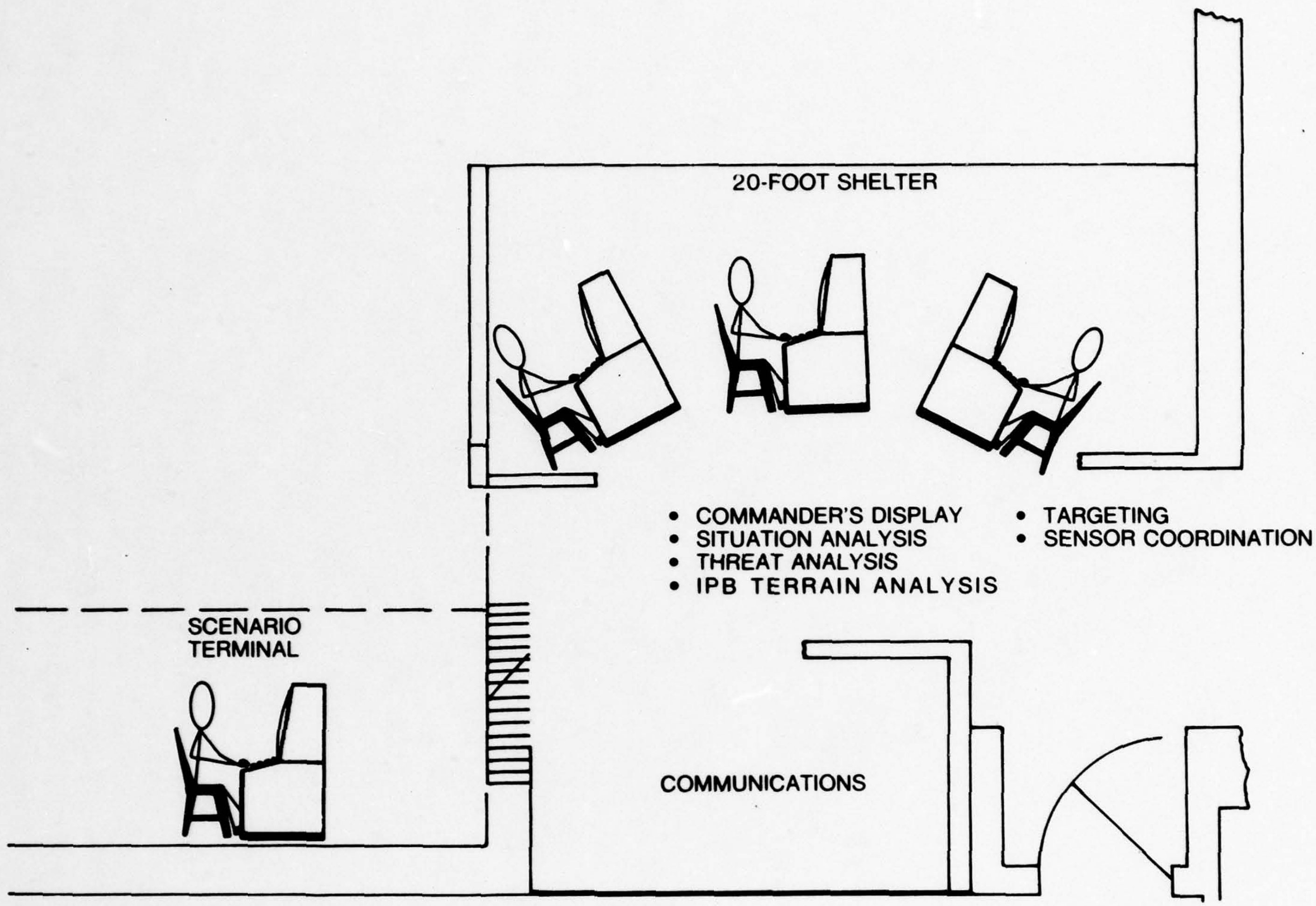

Figure 6.1-1. Layout of the Tactical Systems Demonstration Facility (TSDF)

the DIVRAS contract and has been upgraded through subsequent contract work as well as internal IBM investment. A current system configuration is depicted in Figure 6.1-2.

Another feature of the TSDF is the TOS^2 friendly and enemy order of battle data base, drawn from the data utilized by the Army for FM-222 tests at Ft. Hood. This initial data base (which was built up through additional free-play entries during FM-222) was augmented during DIVRAS with data derived from a 6-hour traffic scenario that produced over 6,000 sensor detections and tactical message inputs to a division TOC. It was later expanded further to include TACC areas of interest, air resource data, and sensor management information.

A DTV system using an IBM 1130 as a controller was utilized for Phase A TIAX experimentation since the software functions already resident in that system and the operator interactions available at function keys required least modifications to accommodate TIAX requirements. The general manipulation capabilities of the 1130 DTV system as applied to both the "compose" and "demonstrate" requirements of TIAX are shown in Figure 6.1-3.

6.2 TERRAIN DATA AVAILABILITY

During the initial task of TIAX Phase A, reviewing the baseline IPB concept and its current status of implementation, it was determined that the most current and comprehensive set of terrain analyses suitable for TIAX use are being produced by the Army's Terrain Analysis Center at Ft. Belvoir. In response to requirements levied by 18th Airborne Corps Hqs., and in support of a separate project sponsored by INSCOM, ETL/TAC is producing sets of 1:50,000 scale clear acetate overlays of terrain subfactor data. Specific overlay types, the

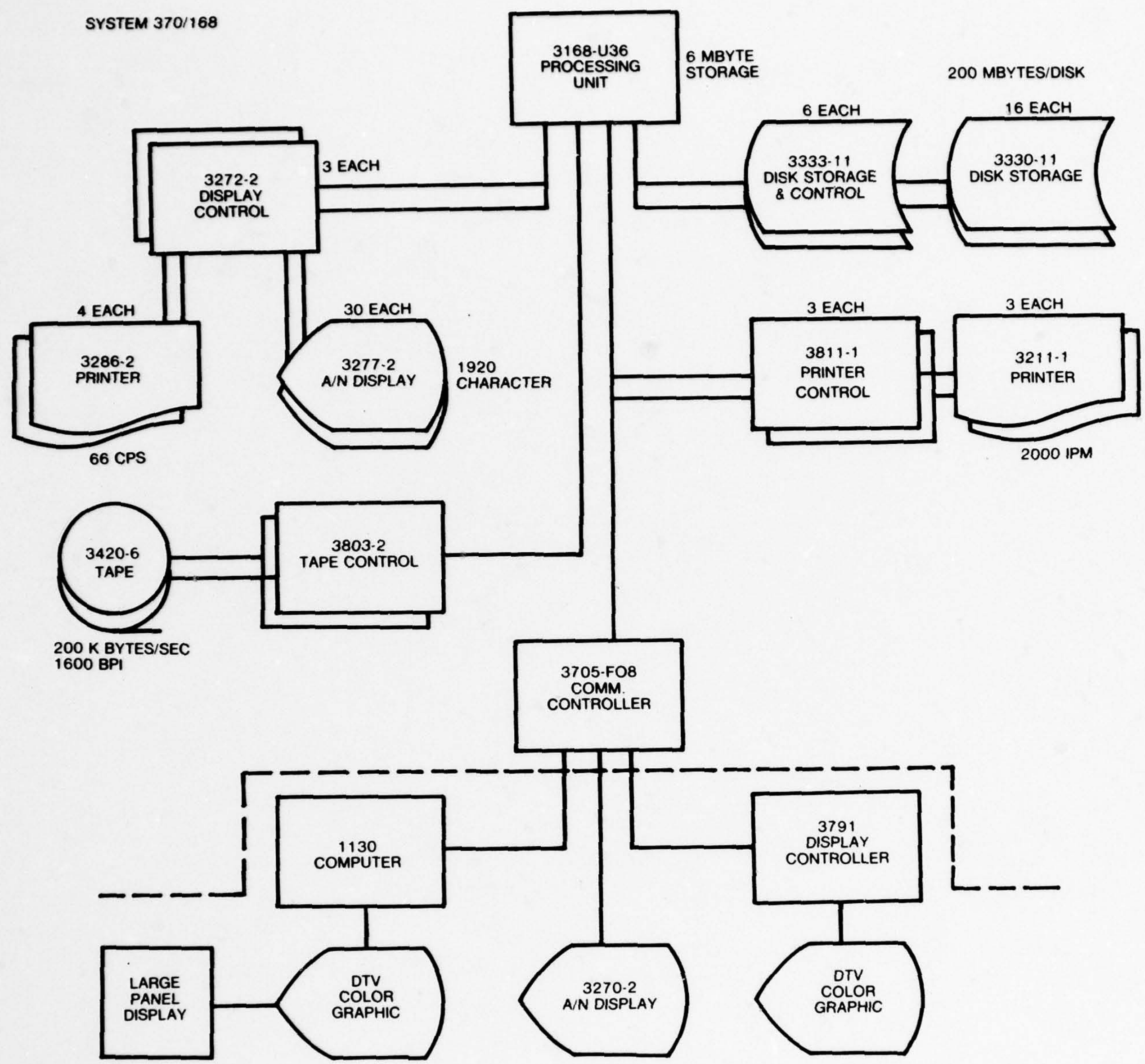

Figure 6.1-2. TSDF System Configuration

COMPOSE MODE	DEMONSTRATE MODE
• Using cursor, digitize line drawings of simplified map backgrounds including roads, rivers, towns, grids, terrain features; annotate with appropriate alphanumeric labels	• Call/Delete map background, military situation, or terrain overlays; display singly or in combination
• Display video image of standard Army map; superimpose symbology representing battlefield situation, or terrain data	• Add, delete, move, modify, annotate unit or threat symbols displayed individually or against map/terrain backgrounds
• Build overlays using special color-coded symbols to depict military mobility over terrain; modify individual symbols or enclosed groups of symbols (cursor identified)	• Delete individual symbols, or classes of symbols, or groups of vectors, or all of a given color
• Build overlays on map backgrounds depicting enemy and friendly situation using standard unit symbols and special threat symbols; add terrain overlays; store/recall full scenes including backgrounds	• Change color of classes of symbols, groups of vectors
• Draw solid or dashed lines; label lines to form unit boundaries; delete line segments	• Call individual scenes from files for display singly or in groups
• Change color of unit symbols, vector symbols, roads, rivers, special symbols (7 colors available)	• Offset and expand in even increments (X1, X2, X4) all vector data on screen
• Build scene; store/recall from temporary working file	• Annotate/modify display, label and store, recall including modifications

Figure 6.1-3. Manipulation Capabilities of 1130 DTV System Used in TIAX

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information included on each overlay, and an overlay extract is presented in Figure 6.2-1. Development of these types of overlays is a meticulous process. Some of the data is derived from the basic maps; however, much of it must be collected from many other diverse sources. Take the vegetation overlay, for example. General areas of vegetation are shown on maps, but this must be upgraded for currency using aerial photography. The specific types and sizes of vegetation are usually discernable from photography. These are plotted to a level of resolution on the overlay of about 1/4" circle--roughly 200m on the ground. The vegetation types are broken down into 46 different categories. They discriminate coniferous forests from deciduous, classify by combinations of height and canopy closure, and include other general forms of vegetation such as swamps, orchards, vineyards, etc. Each terrain factor overlay has similar levels of resolution and detail.

A composite overlay (CCM) is built by first converting pertinent factor overlays to mobility terms. This is accomplished with minor automation support by a series of equations that convert the terrain classifications for each overlay type to a common mobility scale. The factor overlays are then manually combined with each other to build up to the summary composite. The process is time-consuming and arduous, requiring large numbers of computations for each overlay, and careful concentration during manual compositing.

The resulting acetate overlays are quite detailed, and the combination of 11 overlays for each 1:50,000 map square presents the user with a tremendous amount of terrain information about that area. The problem of physically handling the large number of overlays required to monitor even a division area of interest is a serious deterrent to their use, at least in real time during battle conditions.

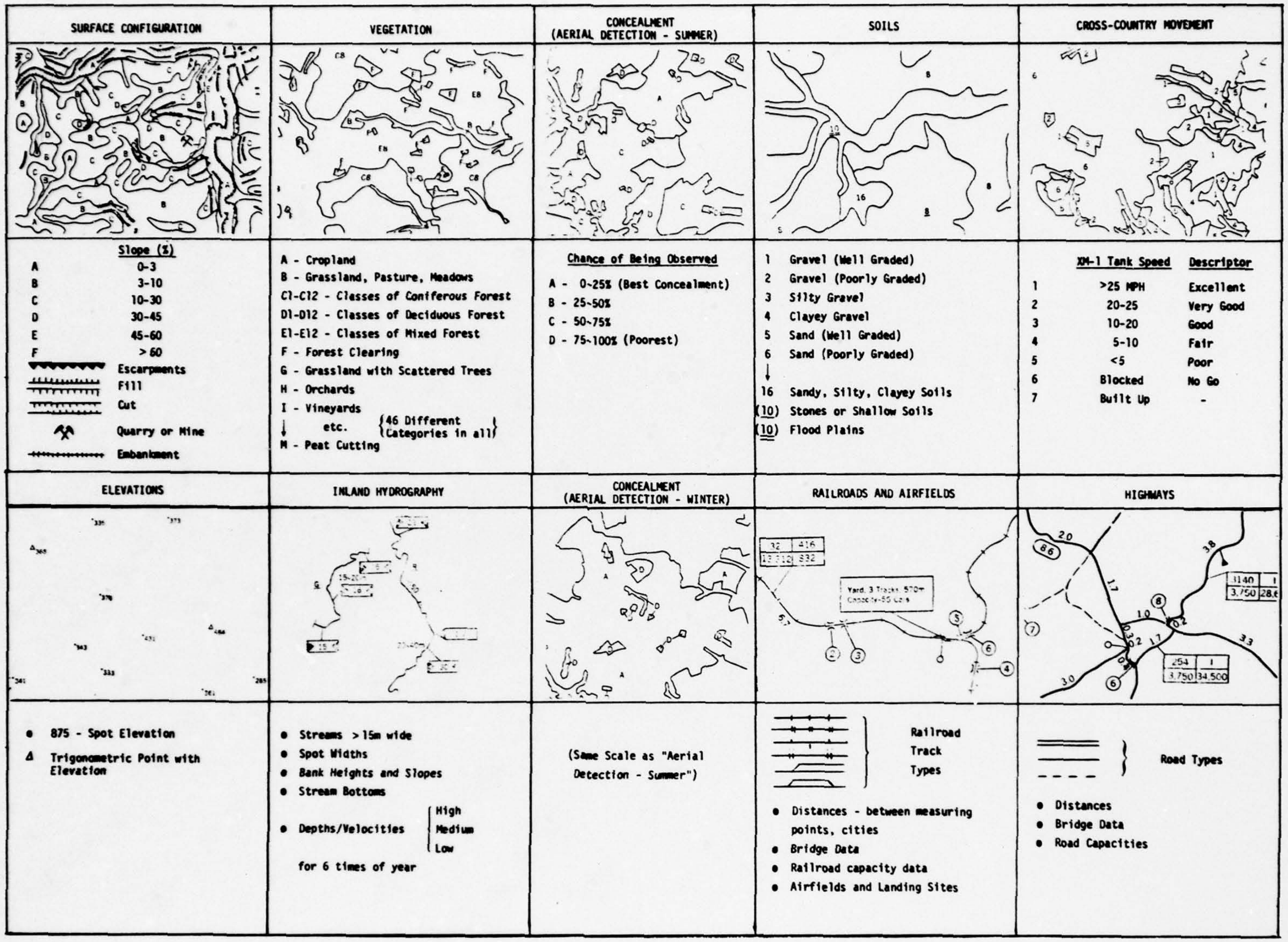

Figure 6.2-1. Terrain Overlays for Manual Use with 1:50,000 Scale Army Maps

This set of overlays is designed to be utilized manually in conjunction with 1:50,000 Army maps as background. In order for this data to be meaningfully manipulated and displayed in an automated system, conversions of scaling information, as well as transfer of the data itself, had to be accomplished. The process of consolidating the multiple overlay legends into a single scale relating to the terrain effect on military mobility was described in Section 5; the procedures for converting the actual terrain sub-factor overlay data into digitized form for experimentation during TIAX Phase A are explained in the next section. In addition, the overlay data had to be inserted into an area around Cleburne, Texas, in order to take advantage of the considerable work already accomplished in developing a scenario driven test bed. This terrain "transplant" was accomplished by developing the 1:250,000 cross-country movement overlay for a 3 map square (N-S) x 4 map square (EW) area utilizing the real data. This was "dropped" onto the Texas lines of communication, and necessary adjustments made. Next, two 1:50,000 map sectors of real data were selected, primarily on the basis of a general "fit" with the Texas river (Brazos). The full set of overlay data for these two 1:50,000 map squares was retained and utilized intact; thus the integrity of the data relationship through the 11 overlays was retained. The 1:50,000 LOC's were tied into the Texas LOC's outside of their map square area, and only at the 1:250,000 scale. The Brazos River was re-shaped (also at the 1:250,000 scale) to conform to the river as it appeared in the real data. Other 1:50,000 squares were placed into the 1:250,000 viewing area so that additional detailed data could be developed if desired in the future.

6.3 DATA CONVERSION PROCEDURES

The acetate overlays provided by TAC/ETL were treated as two different types for input into the IBM seven-color 1130 DTV:

(1) line vector data, which consists of the road, stream, railroad, etc., overlays, and

(2) pattern data, which consists of irregularly shaped areas that identify the characteristics of vegetation, soils, slopes and their composites.

The general data conversion processes for these two types of data are shown in Figure 6.3-1. This approach was selected to take advantage of the existing capabilities of the 1130 DTV as a graphic display system. As currently configured the system can display vector, alphanumeric and specially designed characters in any of seven colors: red, green, blue, cyan, magenta, yellow and white. The screen can resolve 480 pixels vertically and 640 horizontally. However, because of software limitations specially designed character set was limited to a 16 x 16 pixel size. This produces a square about 3/8" on side when displayed on the TV monitor. Since, at a scale of 1:50,000 this is equivalent to a square 0.5 Km on a side, it was adequate for displaying terrain (vegetation, slope, soil, cross-country movement) mobility overlays. The colors and patterns designed for the purpose of displaying terrain mobility are shown in Figure 6.3-2.

Some general requirements for designing the character set were:

1. At least one terrain overlay had to be merged with LOC's, coded streams, military situations, and potential corridors coded for rate of advance.

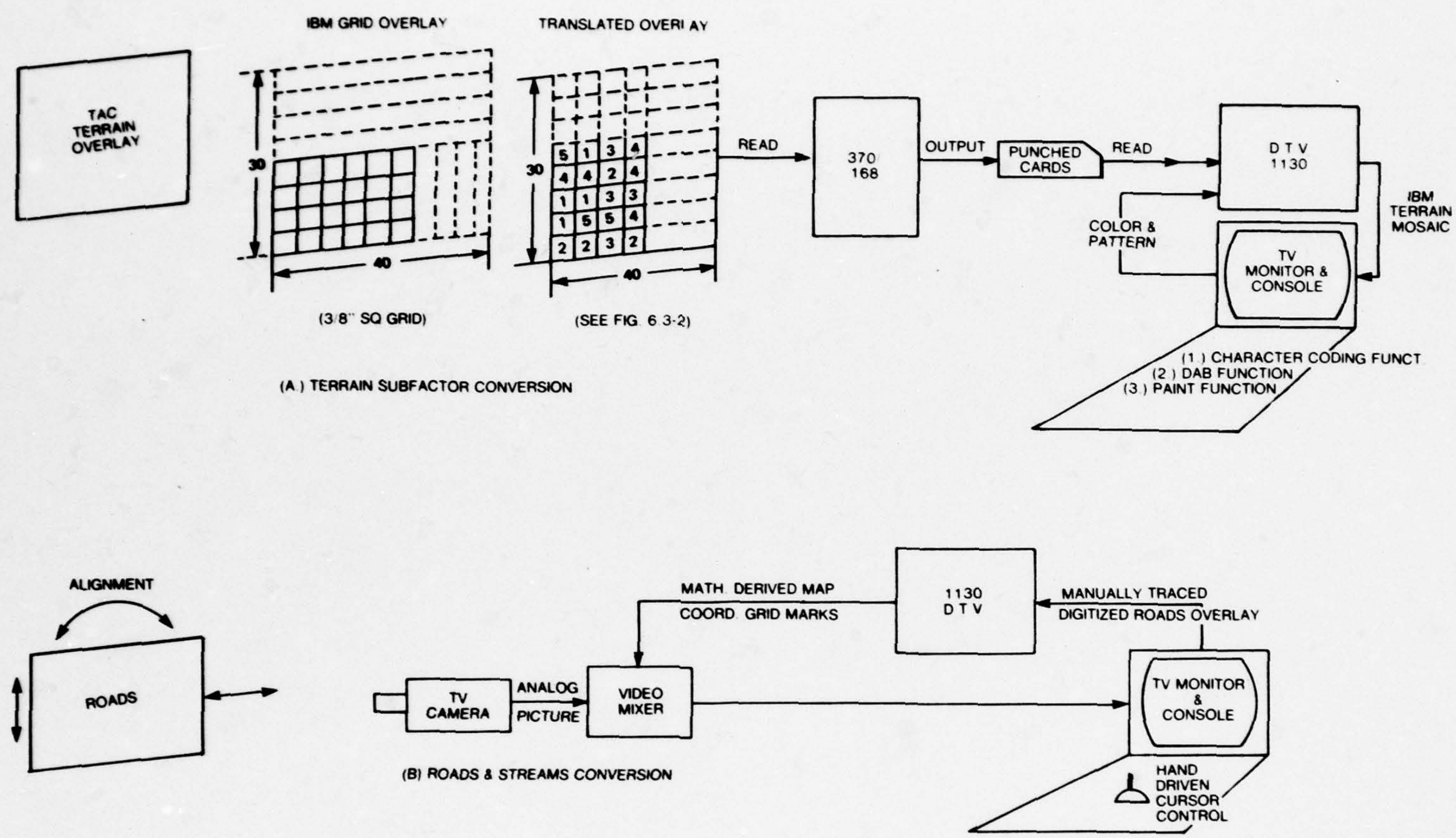

Figure 6.3-1. Data Conversion Process Flow

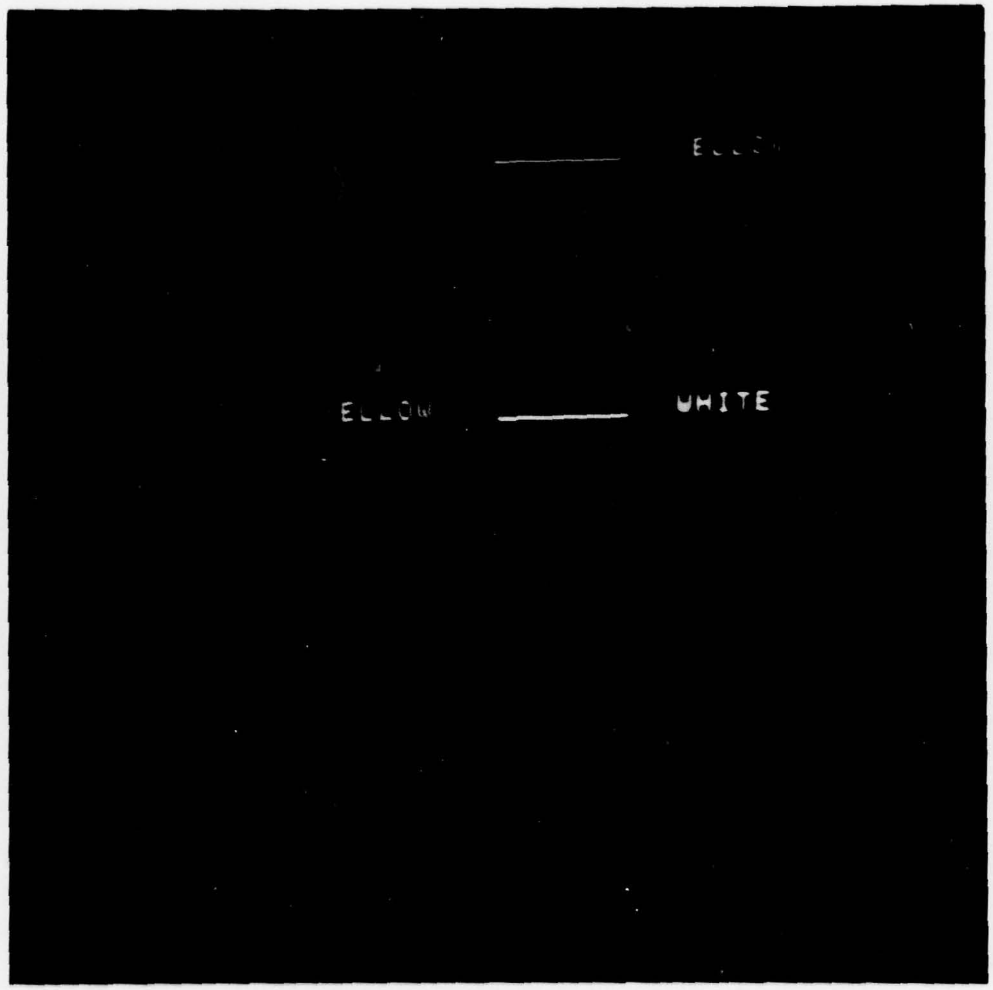

Figure 6.3-2 — Overlay Legend

2. Color and/or shape coding of the different types of data should be easily and quickly interpretable by viewers. That is, minimum learning curve is required. Further, they should stand out so that different types of data (terrain versus roads versus corridors versus military situation) can be differentiated when merged together. The screen should be as uncluttered as possible.

3. For a scale of 1:50,000 the ground resolution of a one-half kilometer on a side will provide sufficiently accurate terrain data representation.

In order to meet the above needs, the 1:50,000 terrain subfactor overlays were manually translated from the acetate format provided by the TAC into terrain mosaics (see (A) part of Figure 6.3-1), each mosaic consisting of 1,200 squares (30 vertical by 40 horizontal). The translation was made by laying a transparent grid on top of the TAC overlay and determining the dominant terrain characteristic in terms of the 5-part mobility scale (go, inhibited, slow, very slow, stop) in each block and recording the data on a worksheet, like that in Figure 6.3-3. This data was then read into an IBM 370 which produces punched cards for reading into the DTV. When the data is input into the DTV, an operator at the DTV console reads the desired characters onto the stored mosaic so that a color coded (i.e., red=stop, green=go, etc.) computer-generated overlay results on the monitor. Two new functions were added to the system: the DAB function, for changing individual elements in an overlay, and the PAINT function for changing groups of elements in an overlay.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
30	5	5	3	5	4	1	5	5	5	1	3	5	5	5	5	1	5	5	5	1	1	4	5	5	5	5	2	1	1	5	5	5	1	5	5	5	1	1	5	5
29	5	5	5	1	5	5	5	2	2	1	1	5	1	5	5	5	5	5	5	1	5	1	5	5	5	5	1	1	1	1	5	5	5	5	5	5	5	1	1	5
28	5	5	1	5	5	5	1	1	5	5	5	3	5	1	1	5	5	5	5	5	5	1	5	5	5	5	5	5	4	1	5	5	5	5	2	1	2	5	1	5
27	5	3	5	5	5	5	5	5	5	5	5	3	5	1	1	5	5	5	2	5	5	5	5	5	5	5	1	5	5	2	5	5	1	4	5	5	4	4	5	4
26	5	3	3	5	5	5	5	1	1	5	1	1	1	1	1	1	5	5	5	1	1	5	5	1	5	5	5	5	1	5	5	5	1	1	5	5	5	5	5	5
25	3	3	3	5	5	5	5	2	1	4	1	1	1	5	5	5	4	5	2	1	5	5	5	4	1	5	5	5	4	5	5	5	1	1	1	2	5	5	1	1
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23	5	5	5	5	1	1	2	5	2	5	1	1	1	1	1	5	1	5	5	5	5	5	5	1	4	2	2	2	2	5	2	2	2	2	5	5	5	1	1	5
22	3	3	5	5	3	5	5	5	5	5	5	5	5	1	1	5	3	5	5	5	1	5	5	5	5	3	5	5	2	2	1	2	5	5	1	5	5	2	1	4
21	1	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5	5	5	1	1	5	5	5	5	2	5	5	4	5	1	5	5	5	5	5	5	4	4	4
20	3	3	5	4	1	1	5	5	5	5	5	5	2	5	2	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	2	2	1	5	2	5	4	4	2
19	3	3	4	4	5	5	5	5	5	3	3	1	5	1	1	2	5	5	5	5	5	5	1	1	5	5	1	1	5	1	3	2	1	1	4	5	5	1	1	2
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17	5	1	5	5	5	3	2	3	2	5	5	5	1	5	5	5	5	5	4	5	1	1	1	4	1	5	5	5	5	1	1	5	5	5	5	2	5	5	5	5
16	5	1	5	5	5	5	3	2	1	1	1	1	1	1	5	3	5	5	4	4	1	1	1	5	5	1	1	1	1	1	1	1	5	5	4	4	5	5	5	5
15	3	5	5	1	1	1	3	2	2	1	1	2	1	1	5	5	5	1	1	5	1	2	5	5	5	1	1	5	1	1	1	1	1	1	2	5	5	5	5	5
14	3	5	5	1	1	1	1	5	1	1	2	2	1	1	1	5	5	5	5	5	2	2	2	2	1	1	5	5	1	1	2	2	3	3	2	5	5	1	5	5
13	1	5	1	1	1	1	1	1	5	2	1	1	1	1	5	5	5	3	1	3	2	1	1	2	2	3	3	3	5	1	1	1	1	1	2	2	3	1	1	2
12	5	5	5	1	1	1	5	5	2	2	2	1	1	1	1	5	5	5	5	2	2	2	2	2	1	1	1	1	5	1	1	1	1	1	1	5	2	1	2	2
11	1	4	5	1	4	4	5	2	2	2	1	1	2	2	2	5	5	5	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	4	2
10	1	1	1	1	1	5	5	5	5	2	5	3	2	2	5	5	1	5	1	5	5	5	5	3	3	1	1	1	1	2	1	1	1	1	1	1	5	2	4	4
9	1	5	1	1	1	5	1	5	5	5	5	5	2	2	2	5	5	3	2	3	5	5	5	1	1	4	2	3	1	1	1	1	1	5	5	5	5	2	5	5
8	1	1	1	5	1	4	5	2	3	2	1	5	2	2	5	5	5	5	5	5	1	2	1	1	1	1	1	1	1	2	3	1	1	3	5	5	5	5	5	2
7	1	1	1	1	1	5	1	2	2	5	1	2	1	2	3	5	5	1	5	4	4	1	2	2	1	1	1	4	2	2	1	2	2	4	5	5	5	5	1	2
6	5	5	1	1	1	2	2	2	1	2	5	5	4	1	5	5	5	1	1	1	1	1	5	2	2	1	1	4	4	4	1	2	1	2	2	5	5	1	1	2
5	1	1	1	1	1	1	1	5	5	5	5	2	2	1	1	1	1	1	1	1	5	4	4	5	1	1	1	1	1	4	4	4	1	3	5	1	5	1	5	2
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3	2	5	5	5	5	5	1	5	2	5	1	5	5	5	5	1	1	1	1	1	1	1	1	5	5	1	1	1	1	1	1	1	1	1	1	1	4	4	5	5
2	2	1	1	5	1	1	4	2	5	5	2	2	5	5	5	5	1	1	1	1	1	1	1	2	5	4	5	1	1	1	4	1	1	1	1	2	1	1	5	5
1	5	2	5	1	1	1	1	4	1	5	2	4	4	4	5	5	5	5	1	1	1	1	5	2	5	5	5	1	1	2	5	4	1	1	1	1	1	5	5	2

Figure 6.3-3. Cross Country Movement Worksheet Matrix

The process used for digitizing the line vector data is depicted in the (B) part of Figure 6.3-1. Here, the TAC acetate overlay is mounted and then "read" by a conventional TV camera. The analog output is video mixed with mathematically derived and digitally generated map coordinates. The mounted overlay is then aligned with the digitally generated coordinates. When appropriate alignment is attained an operator at the DTV console traces the analog overlay on the screen by using the cursor driven by the joy stick. The digitized screen coordinates of the vectors drawn are stored and the overlay becomes available for digital manipulation and/or display.

SECTION 7. TIAX EXPERIMENTATION - RESULTS AND RECOMMENDATIONS

In this section the results of Phase A of the TIAX Program are presented in terms of descriptions and examples of the end products plus a summary of what was learned and resulting recommendations. Section 7.1 will describe (1) the demonstration sequence, keying parts of the sequence to color photographs of selected display scenes; (2) the graphic scenes of data contained in the demonstration data base in the TSDF; and (3) the scenario data utilized as background for developing a realistic military application of analyzed terrain information.

7.1 DESCRIPTION OF TIAX PHASE A END PRODUCTS

In order to demonstrate the automated IPB terrain analysis products in an operational environment, the demonstration sequence was based on DIVRAS scenario data (SCORES II) already developed and resident in the TSDF. The scenario data portion selected deals with second echelon movements during the early morning of D+3. Figure 7.1-1 indicates the general battlefield situation at 0930 hours on D+3 at which point the IPB terrain analysis is performed in the demonstration sequence. Figure 7.1-2 is a summation of the scenario actions used as a basis for the TIAX Phase A demonstration sequence. Time phased enemy unit locations over the indicated time period are a part of the data base.

Figure 7.1-3 shows one of the demonstration sequences used to illustrate the operational utility of TIAX terrain and mobility overlays. In this demonstration there is representative dialogue between the G-2 and Division Commander concerning a suspected envelopment movement that brings out how various combinations of terrain overlays could be combined to support the Commander's decision process.

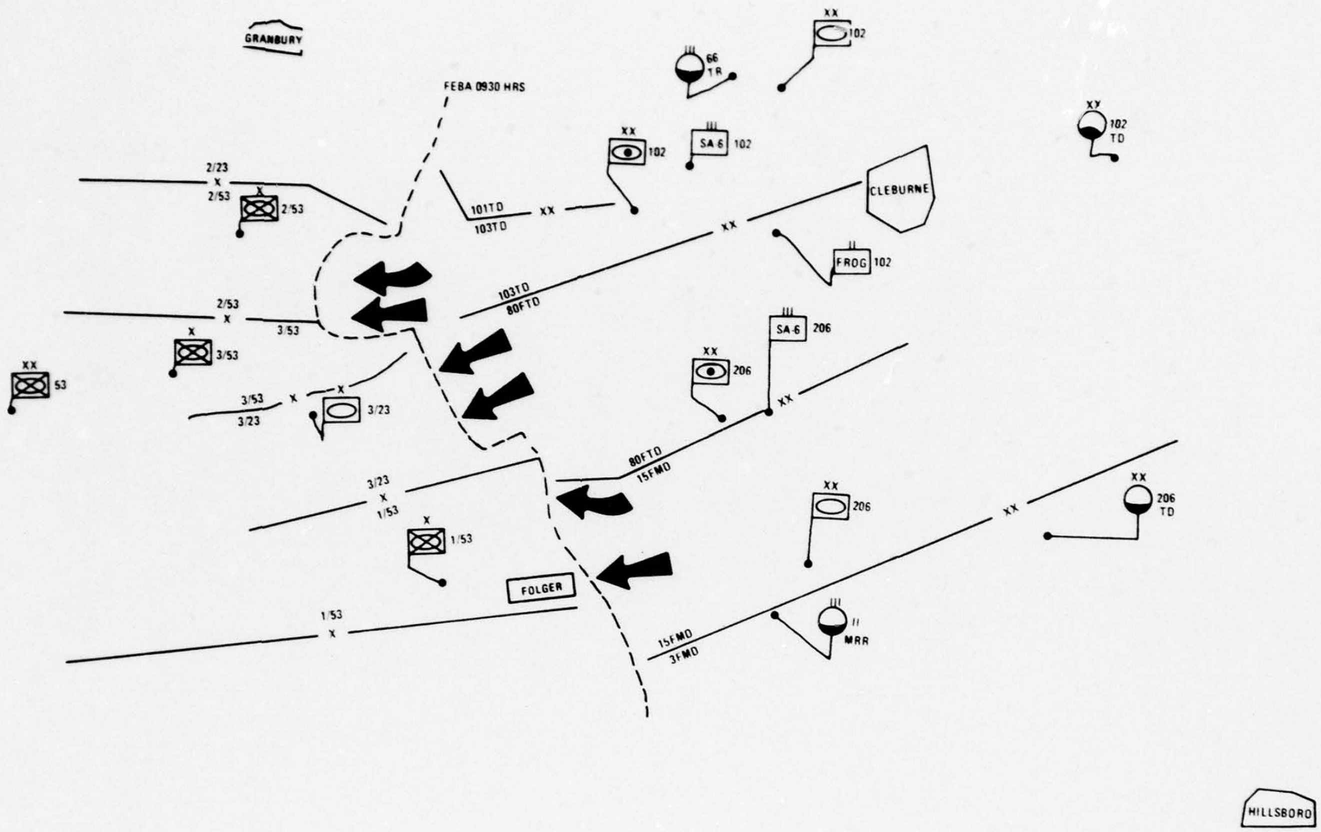

Figure 7.1-1. ENEMY AND FRIENDLY TROOP DISPOSITIONS AS OF 0930 HRS D+3.

TIME	RED FORCES ACTION	U.S. ACTION
0310	206F TD Opcon'd to 16 TA leaves assembly area (PL940354) of 12 TA toward projected exploitation line in 15F MD sector with objective to begin attack at 1200 hours, cross Brazos River south of Plowman and moving northwest of White Bluff to envelope U.S. 23 AD and 53 MD divisions. 206F TD exercises radio silence.	
0325	SA-6 Regiment arrives at 102 TD assembly area (PL815714).	
0330	3 battalions of 1st TA Artillery leave PL815654 to support 206F TD in 15F MD area.	
0355	1 FROG battalion leaves PL815654 to support 206F TD in 80F TD area.	
0405	Division Supply Point for 102 TD established at PL650834.	
0410	3 battalions of 102 TD Artillery leaves assembly area PL815714 to support 102 TD in 101 TD area.	
0415	Division Supply Point for 206F TD established PL620594.	
0417	1 FROG battalion leaves PL815714 to support 102 TD in 101 TD area.	
0440		171 AAC FARRPS established by Corps in 23 AD area at PL040584 and NL970804.
0500	SA-6 Regiment moves forward from rear area PL815714 to support 102 TD in 101 TD area	

Figure 7.1-2. Scenario Actions - Recognition of 2nd Echelon Activities (Sheet 1 of 3)

TIME	RED FORCES ACTION	U.S. ACTION
0530	102 TD leaves assembly area (PL815714) for rear of 80F TD to pass through 101 TD and cross the Brazos River in 1/23 sector, intersect Highway 377 and head southwest of White Bluff to envelope 23 AD and 53 MD.	
0554	FROG battalion, attached to 206F TD, in position at PL530584.	
0559	3 batteries of SA-6 AD units move forward from PL630774 to support 206F TD operations.	
0604	206F TD Artillery support in place in area of PL410654 northwest of 15F MD Artillery positions.	
0609		CAC provides 53 MD TOC with report on radio silence by 206F TD; location of division presently uncertain.
0630	Lead elements of 102 TD at PL590784.	
0637	102 TD Artillery in place in the area of PL350784 southwest of 101 TD positions.	
0652	102 TD FROG battalion in position at PL440794.	
0700	GSP ferry material arrives at Regimental Supply Depot of 11 MRR/206F TD at PL450534.	
0710	206F TD enters 15F MD rear on Highway 67 PL575581, significant increase in communications traffic of 15F MD in coordinating movement.	

Figure 7.1-2. Scenario Actions - Recognition of 2nd Echelon Activities (Sheet 2 of 3)

TIME	RED FORCES ACTION	U.S. ACTION
0735	102 TD enters 101 TD rear on Highway 171 at PL519815, significant increase in communications traffic 101 TD in coordinating movement.	
0759	102 TD's SA-6 Regiment in place at PL380814.	
0805		I Corps commander orders 53 MD to shift 2nd Echelon Battalions north to 23 AD boundary to provide better location for rapid movement to 1/23 sector. 53 MD orders TF2-44 (PL030774) and TF3-36 (PL040744) northward.
0825	SA-6 support batteries for 206TD operations in place at PL430624.	TF2-44 and TF3-36 reach Highway 201 at PL027813 and PL032801 respectively.
0829		CAC provides *codeword report* on 15FMD and 101TD rear communications activity.
0850		I Corps modifies air operations plan to provide for TACAIR interdiction strikes in 2nd Echelon of 101TD at 1030 and in 2nd Echelon of 15FMD at 1130.
0902		Corps commander orders 53MD to release 1-14Cav (PL100694) so that it may revert to 14ACR(-) for operations in 1/23 sector. Helo transport to be provided at 1015.
0912	102TD at Battalion/Company dispersal point (PL440864).	
0920	206TD at Battalion/Company dispersal point (PL470564)	
0930	Red TACAIR strikes initiated simultaneously on 1/23 and 2/23 sectors.	
0935		Preplanned air cavalry assault by 171AAC Bde initiated against 64TR at (PL160724).

Figure 7.1-2. Scenario Actions - Recognition of 2nd Echelon Activities (Sheet 3 of 3)

SCENE	G2	COMMANDER	EXAMPLE DISPLAYS
1		Commander enters and notes the report of commander of 53rd concerning two large mobile forces and suspected assembly areas asks for situation.	
	Indicates that section has been working the problem and that he suspects the enemy is attempting an envelopment with 2 Divisions, probably the 102 TD and the "lost" 206 GTD.	Commander asks why he suspects this.	
	G2 notes units in assembly areas well to the north and south of river penetration. He also cites the detection of pontoon bridging and ferry material which would not be needed in areas where they are already across; only in the less favorable areas to the north and south.	Commander asks whether they have determined the likely axis of the two attacks and the point of river crossing.	
2	G2 indicates they have been reviewing the terrain carefully and will show him their conclusions. He tells operator to bring up Cleburne Terrain and indicates likely routes and crossings.	Commander asks for a closer look at Folger crossing area.	Figure 7.1-4. 1:250,000 Cleburne Map and Cross-Country Movement (HJD)
3	G2 orients commander to Folger map by indicating river, key towns, and the key road and key bridges. He then notes by name (2-37, 1-58, 2-44) the three battalions in the area and recent Red force movement.	Commander asks what the cross-country possibilities are for the area.	Figure 7.1-5. 1:50,000 Folger Map and Cross-Country Movement (HJD)
	G2 asks for Folger Cross-Country Movement. He immediately focuses on his previous analysis of the river and notes that most likely area for crossing. He asks operator to explain the four potential crossing points (including 2 bridges which will take armor).	Commander asks why approaches to river are denied in the eastern half of scene. Is it a slope?	
4	G2 says he will run through the factors for the commander and calls for Folger Slope. He notes no denial because of slope along the river and then asks for vegetation.		Figure 7.1-6. 1:50,000 Folger Map and Slope
5	G2 notes that vegetation is the key factor and notes the national forests in the area.		Figure 7.1- 7. 1:50,000 Folger Map and Vegetation

Figure 7.1-3. TIAX Phase A Demonstration Sequence Folger River Crossing (Sheet 1 of 2)

SCENE	G2	COMMANDER	EXAMPLE DISPLAYS
6	G2 shows that soils are not a factor.	Commander notes that weather forecast is good but he would like to know how these would change if it rains heavily in the afternoon.	
7	G2 asks for Wet Soils map and notes that if rain were to be heavy the picture would change considerably in areas at river crossings.	Commander asks about the enemy options of sticking to the roads.	Figure 7.1-8. 1:50,000 Folger Map and Soils (Wet)
8	G2 calls for Lines of Communications and explains the road mobility scheme and the 3 or 4 roads that may figure in attack.	Commander asks to see this in relationship with rivers.	Figure 7.1-9. 1:50,000 Folger LOC's and Wetlands
	G2 calls for rivers and notes the area where the width of river is an impediment if the bridge is lost.	Commander asks the G2 for the "net" of his analysis.	
	G2 calls for Cross-Country and asks operator to draw the potential corridors.		Figure 5.4-1. 1:50,000 Folger Combined Obstacles (HJD)
	Then tells commander that he will indicate these corridors in terms of enemy's mobility.		
9	G2 shows corridor options and explains the mobility ratings. Then notes that he can drop combined obstacles for simplicity.	Commander asks if he has discussed potential barrier plan with G3.	Figure 7.1-10. 1:50,000 Folger Combined Obstacles and Mobility Corridors (HJD)
	G2 indicates that they have a plan and he calls for it.		
9a	G2 explains each obstacle and what it denies.	Commander asks what the result is if the plan is implemented.	
	G2 asks operator to delete denied corridors.	Commander asks if a maneuver plan has been discussed with G3.	Figure 7.1-11. 1:50,000 Folger Vegetation, Barrier Plan, and Modified Mobility Corridors (HJD)
9b	G2 calls for Current Force picture in the area and notes favorable interdiction points.	Commander asks if there is favorable high ground or cover.	
9b	G2 calls for slope overlay and notes on rolling hills in area. He then calls for vegetation and notes areas of concealment.	Commander asks if G3 has a potential plan.	
	G2 indicates that G3 has suggested to Division the movement of four battalions into the area and he explains placement in town and wooded areas while operator places blockers. He notes that Corps may have to commit its ACR reserve to accomplish this.	Commander indicates that he will get with G3 on the plan and talk to Division commanders to get their opinion.	

Figure 7.1-3. TIAX Phase A Demonstration Sequence Folger River Crossing (Sheet 2 of 2)

In this instance an analysis using automated terrain overlays in consonance with military situation overlays has enabled the G-2 to predict likely river crossing points and enemy corridors of advance. The figure also references a set of color photo reproductions of actual displays at various points in the demonstration sequence. These were selected from a total of approximately 25 to illustrate the variety of composite scenes displayed.

In Figure 7.1-4 a Cross-Country Movement (CCM) overlay is displayed over a map background and military situation overlay. In this case, a two-color mobility scheme was used (Green=GO, Red=STOP) as a general indication at the smaller scale (1:250,000) of where the terrain can be traversed cross-country. The terrain data was compiled for weather conditions on a "hot July day" (indicated "HJD" in the figure title).

Figure 7.1-5 is an enlargement to 1:50,000 scale of the area southeast of Folger in which a composite of the more detailed map background, the military situation overlay in that area, and the cross-country movement (CCM) terrain overlay are displayed together. On this CCM the full 5-part mobility scale is used, indicating the summary of terrain mobility factors for slope, vegetation and soils in mobility terms ranging from STOP (red) through VERY SLOW (magenta), SLOW (yellow), INHIBITED (cyan) to GO (green). The color/pattern legend is shown in the upper right hand corner of the picture. (An enlarged version is given in Figure 6.3-2.) This scene allows interpretation of the total cross-country terrain situation in context with a map and current enemy/friendly force locations.

Figures 7.1-6 and 7.1-7 are scenes comprised of the same sets of overlays except the CCM overlay has been replaced by terrain factor overlays, in these cases slope and vegetation. The same mobility

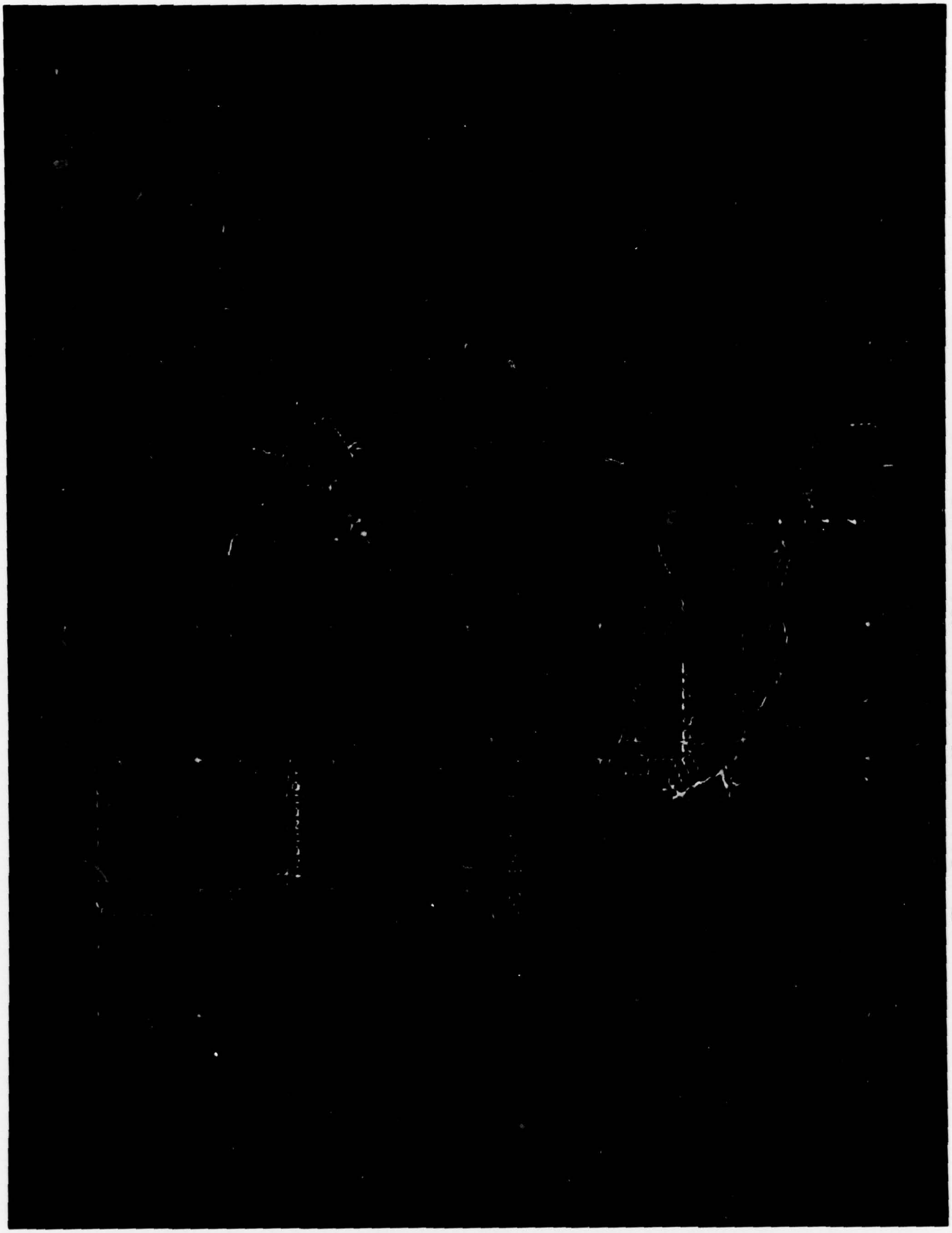

Figure 7.1-4 — 1:250,000 Cleburne Map and Cross Country Movement (HJD)

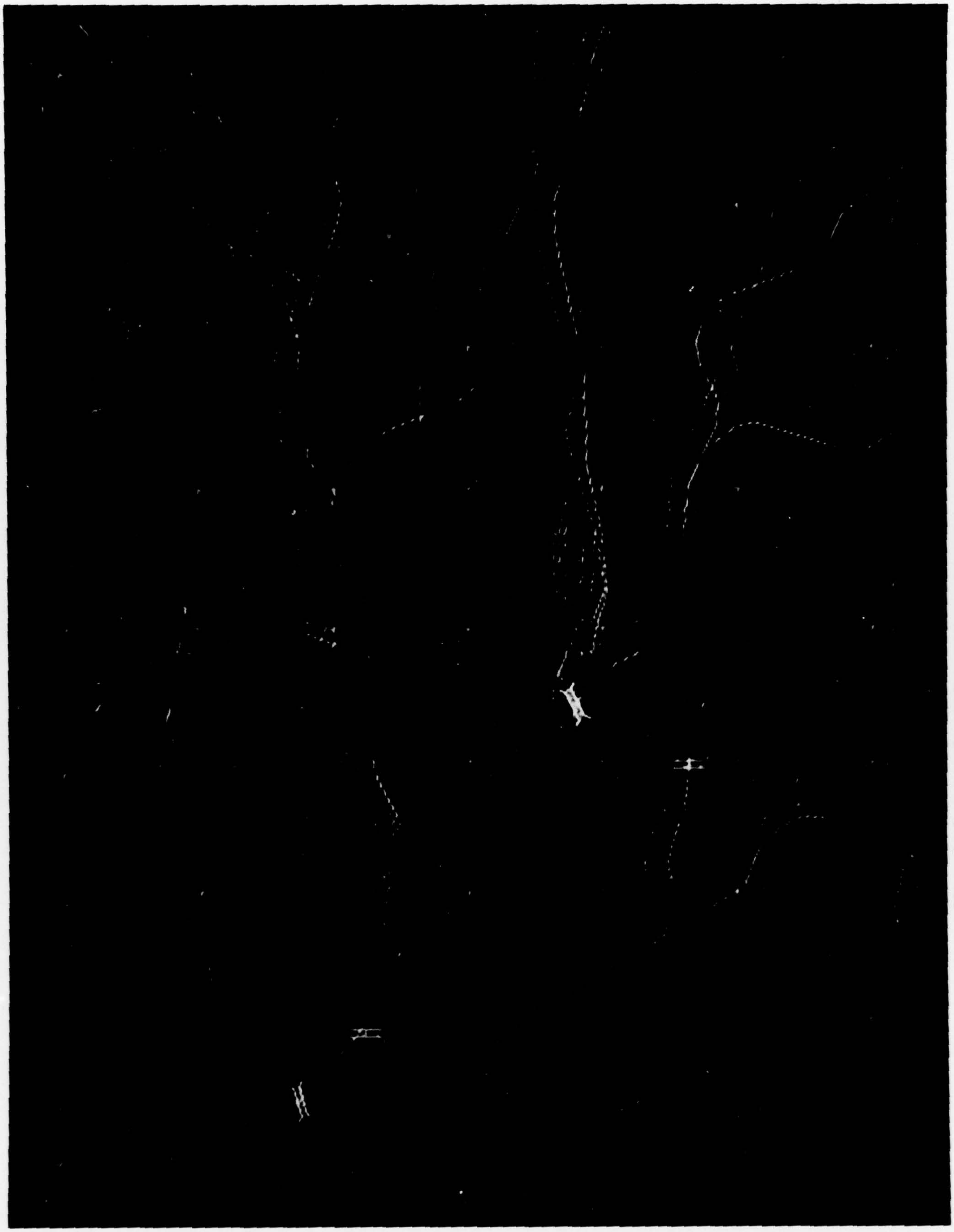

Figure 7.1-5 — 1:50,000 Folger Map and Cross Country Movement (HJD)

Figure 7.1-6 — 1:50,000 Folger Map and Slope

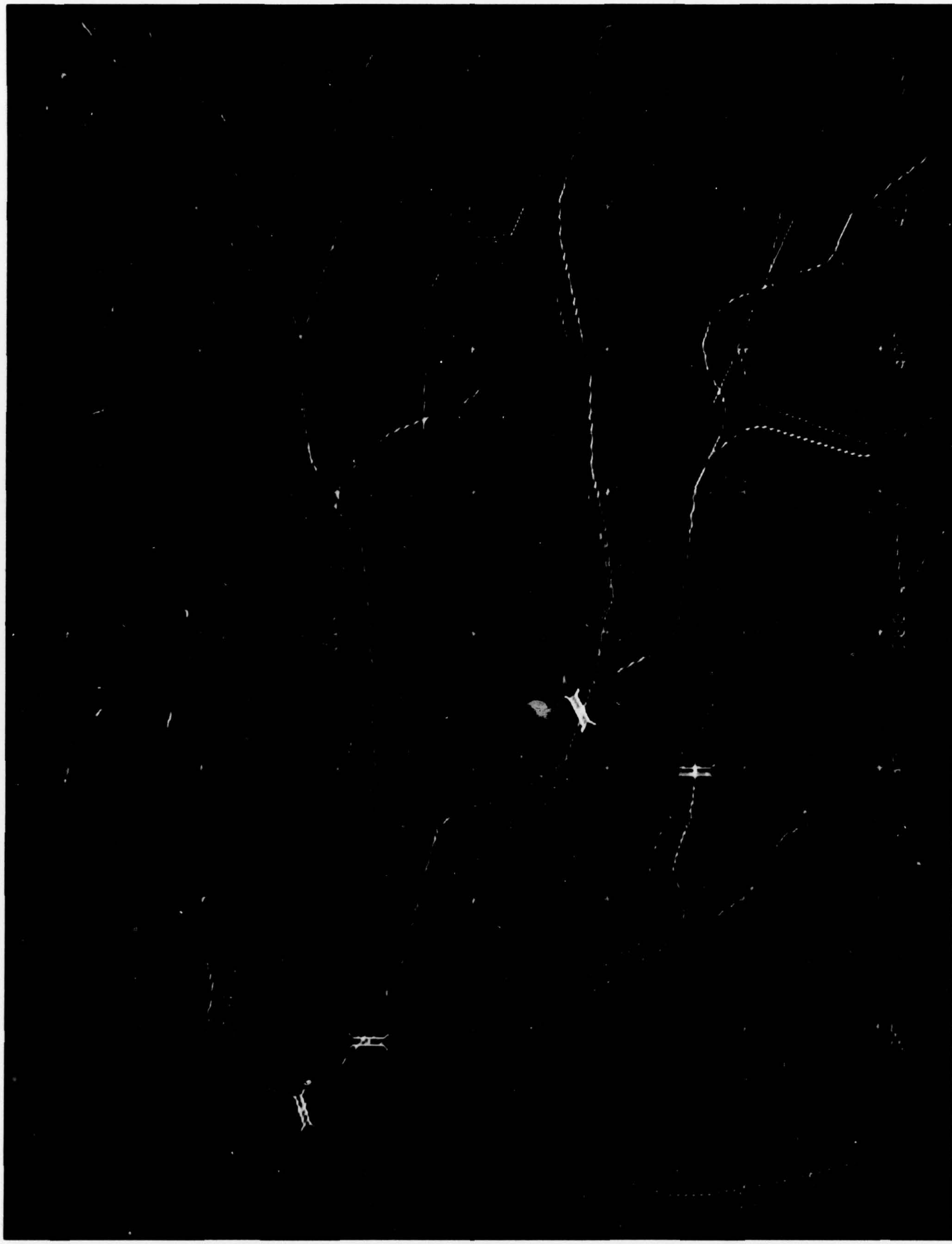

Figure 7.1-7 — 1:50,000 Folger Map and Vegetation

scale and color coding is used, and thus they look exactly like the CCM overlay. The data, however, represents the effects on mobility of that terrain factor only.

Figure 7.1-8 shows the same scene but with the soils overlay represented at a time when the soil is saturated with water. This in conjunction with the soils overlay on a hot July day provides the full range of effects on mobility due to soils. This approach allows the analyst to judgmentally interpret the impact of rainfall, taking into account how much rain for how long, slope factors, wind and other drying factors, etc.

In Figure 7.1-9 the map background has been mobility color coded to form the lines of communications (LOC's) overlay; it is displayed together with the mobility color coded wetlands overlay (basically rivers and streams in this case). To facilitate visual discrimination of roads versus rivers, the following modified color coding scheme is used:

<u>LOC's</u>	White = GO+ = superhighways and primary roads
	Green = GO = secondary roads
	Yellow = INHIBITED = connecting roads
<u>WETLANDS</u>	Cyan = GO = Width <6m and Depth <5.5m
	Blue = SLOW = Width 6-40m or Depth >5.5m
	Magenta = VERY SLOW - Width 40-1,000m and Depth >5.5m

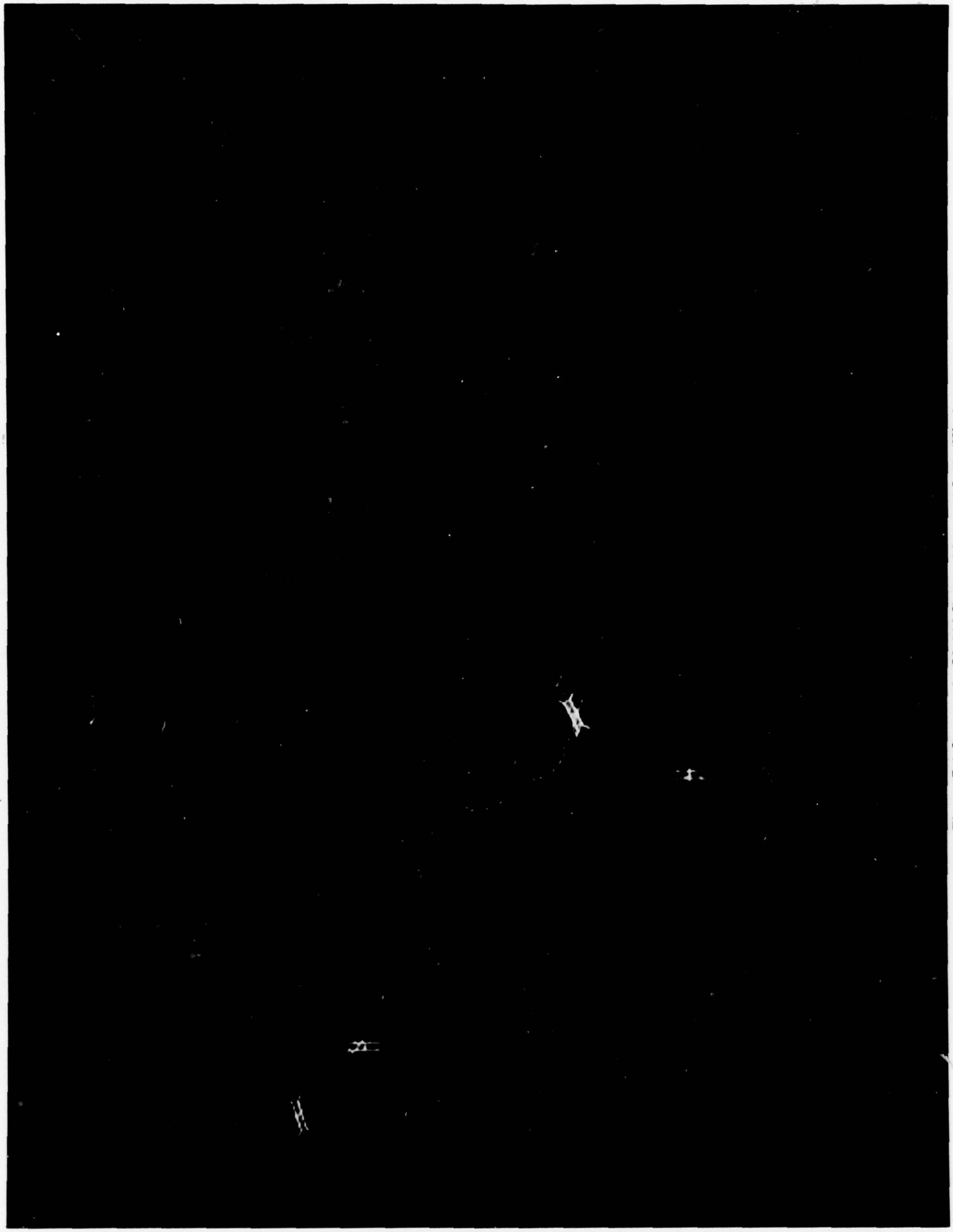

Figure 7.1-8 — 1 : 50,000 Folger Map and Soils (Wet)

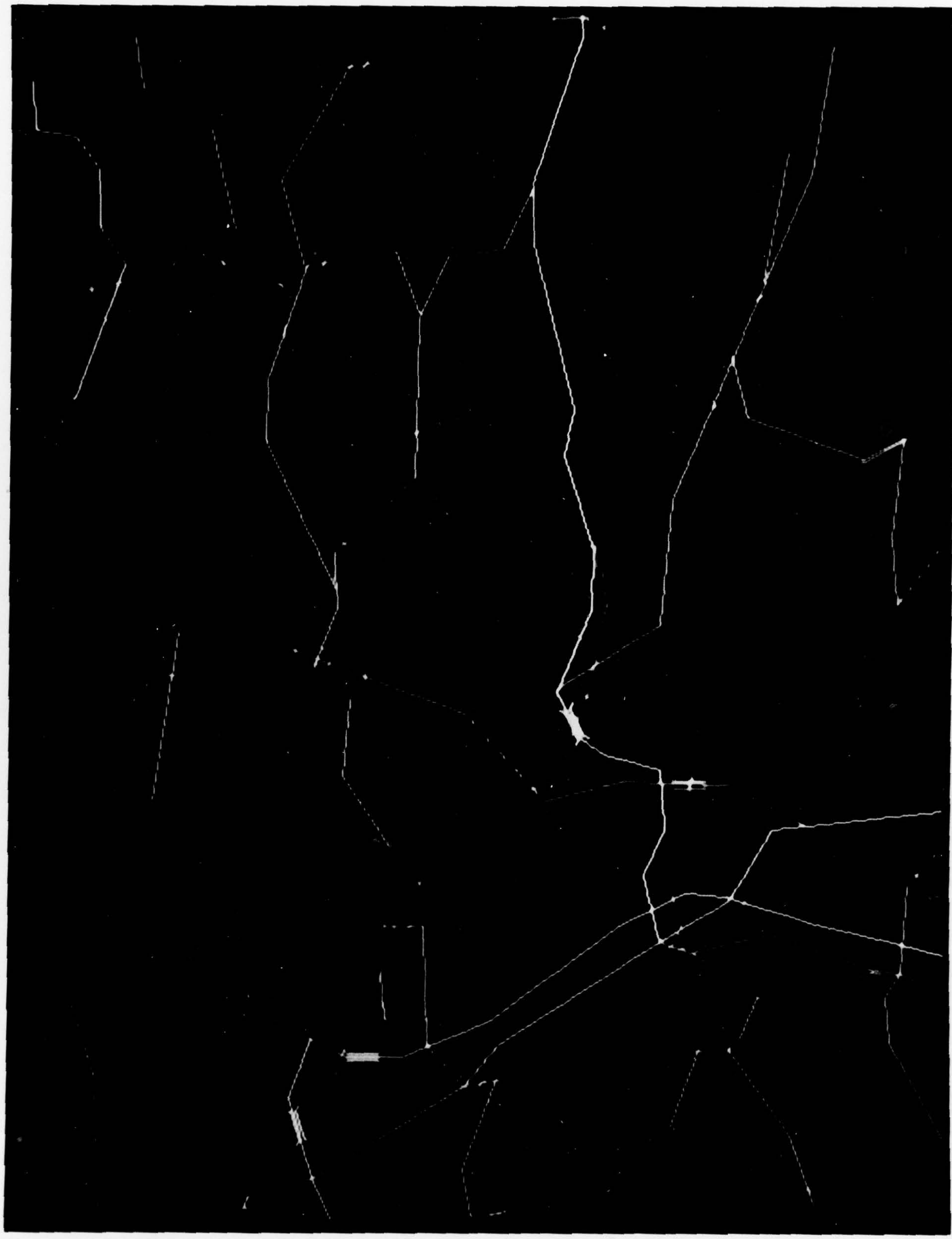

Figure 7.1-9 — 1:50,000 Folger LOC's and Wetlands

The purpose in presenting roads and rivers in this way is to convert all terrain factors that can influence military ground movements to a single mobility scale, so that the overall effects of terrain (including roads, rivers and built-up areas) on troop movements can be assessed.

An explanation of the basis for these mobility ratings is included in Section 5.

As indicated earlier, Figure 5.4-1 is a color photo of the combined obstacles overlay. This assembles the net effect of all terrain influences on mobility onto one display. It consists of the cross-country movement (CCM), LOC's and wetlands overlays. With this total mobility picture, plus knowledge of where the enemy is now and assumptions about where he wants to go, the analyst can identify and trace out the mobility corridors available. In Figure 5.4-1, knowing that (1) the red force is moving into the scene from off screen to the upper right; (2) he will probably try river crossings somewhere in the left half of the screen; and (3) the green and cyan areas are favorable terrain, the red and magenta unfavorable, and the yellow marginal, the intelligence analyst can quickly trace the corridors of advance the enemy has available to him.

Figure 7.1-10 shows the results of that analysis. The mobility corridors outline probable enemy routes toward assumed objectives, taking into account the mobility effects of terrain and LOC's. The cyan corridor in the center is the one that affords most rapid advance toward assumed crossing areas. The color codes indicate that the central (cyan) corridor will sustain a mobility rate of INHIBITED (nominally 3.75 battalions/hour) for a regimental size force while the yellow corridors will sustain a regimental rate of SLOW (nominally 1.6 battalions/hour). The ratings of the corridors are determined based on the choke point within the corridor,

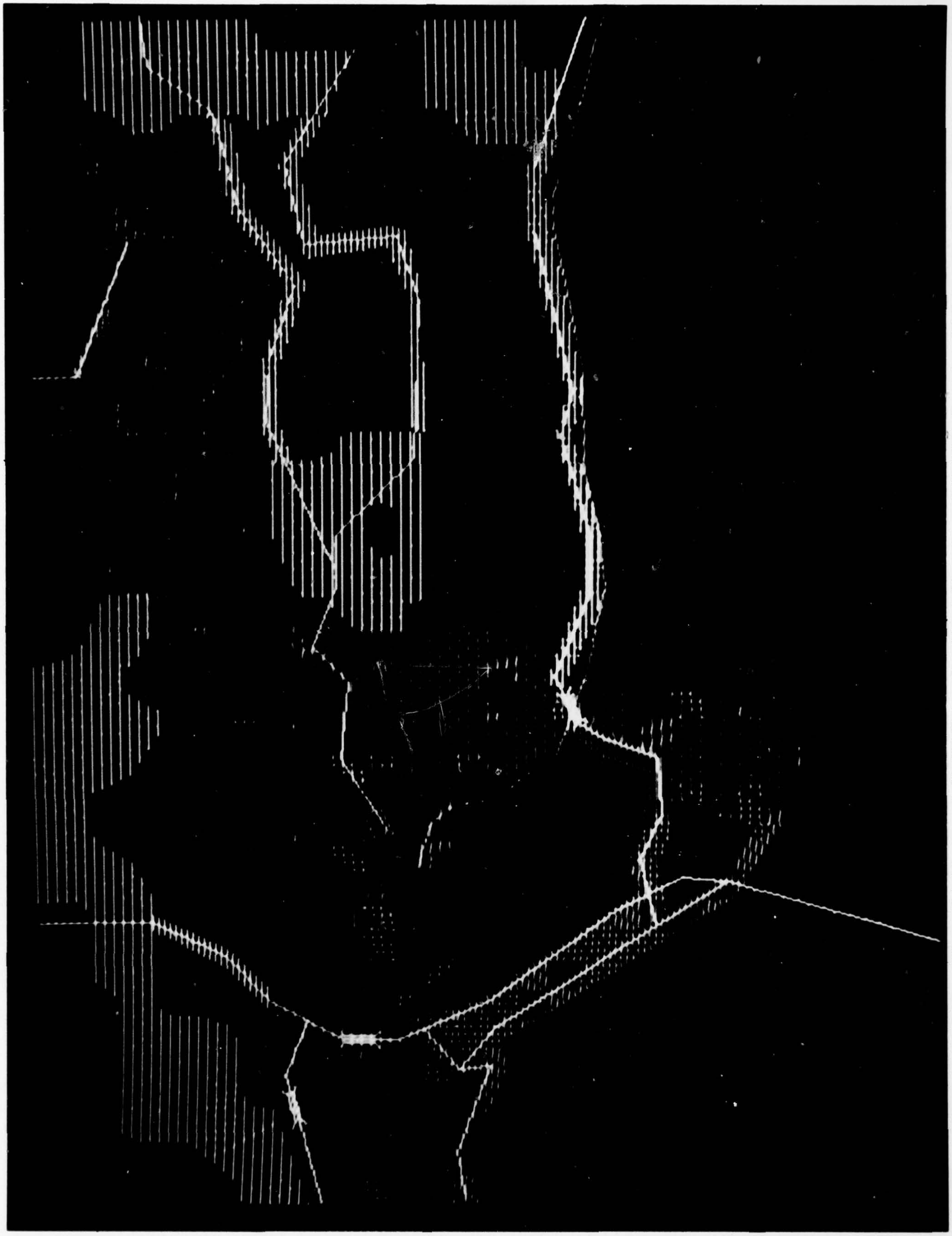

Figure 7.1-10 — 1:50,000 Folger Combined Obstacles and Mobility Corridors (HJD)

and take cross-country terrain and LOC's into account (LOC's are usually not limiting). A more detailed explanation of mobility corridor rating is contained in Section 5.

In Figure 7.1-11, the effect on mobility corridors of implementing a barrier plan is illustrated. The solid red circles represent mining the roads, and the red cross-hatched triangle indicates the demolition of a bridge. The display shows the resulting corridor situation (assuming those actions are carried out) superimposed on the CCM, military situation and barrier plan overlays.

These and other display scenes are stored on disk in the 1130 DTV system in the TSDF. The scenes were digitized in layered sets of data called overlays, thereby enabling various combinations of elements to be fitted into different demonstration sequences. The set of overlays utilized in the demonstrations given during the latter part of TIAX Phase A is presented in Figure 7.1-12.

7.2 RECOMMENDATIONS

The study and demonstration efforts reported herein have been an attempt to define IPB techniques and automation aids in an integrated functional concept capable of incorporation in a Corps or Division TOC. Recommendations for further effort in this direction are offered below.

- Study results suggest that the Army examine more thoroughly the echelons in which a fieldable IPB system would logically be applied. It is IBM's initial finding that the automated IPB package has most chance for success if applied at the corps and division TOC echelons. Friendly staff elements at these echelons are concerned dominantly with movements of larger enemy forces over the ground. It appears feasible to analyze in advance the corridors/terrain accessible to these

Figure 7.1-11 — 1:50,000 Folger Vegetation, Barrier Plan & Modified Mobility Corridors (HJD)

TITLE	SCALE	DESCRIPTION
1. Cleburne Map	1:250,000	Roads and Bridges, Town Boundaries, Coordinates, Grid Ticks, Main River, Folger and Granbury Map Boundaries Outlined
2. Cleburne Military Situation	1:250,000	Enemy and Friendly Unit Locations and Boundaries, FEBA
3. Cleburne Cross-Country Terrain	1:250,000	Two Color Cross-Country Movement, abbreviated Military Situation, Map Background
4. Folger LOC's	1:50,000	Folger Roads Color Coded for Mobility, Town Boundaries
5. Folger Map	1:50,000	Roads, Streams, Town Boundaries, Map Coordinates and Grid Ticks
6. Folger Wetlands	1:50,000	All Rivers and Streams Mobility Coded
7. Folger Military Situation	1:50,000	Enemy and Friendly Unit Locations, FEBA
8. Folger Obstacle Plan	1:50,000	Mined Roads, Blown Bridges
9. Folger Map and Military Situation	1:50,000	Roads, Streams, Town Boundaries, Map Coordinates, Grid Ticks, Enemy and Friendly Unit Locations, FEBA
10. Folger Vegetation	1:50,000	5 Color Coded Overlay - Mobility as a Function of Vegetation
11. Folger Cross-Country Movement	1:50,000	5 Color Coded Overlay - Product of Vegetation, Slope, Soils
12. Folger Soils	1:50,000	5 Color Coded Overlay - Mobility as a Function of Soils
13. Folger Slope	1:50,000	5 Color Coded Overlay - Mobility as a Function of Surface Configuration
14. Folger Mobility Corridors	1:50,000	5 Color Coded Overlay - Mobility as a Function of Mobility Corridors
15. Folger Soil (Wet)	1:50,000	5 Color Coded Overlay - Mobility as a Function of Wet Soils and Flooding
16. Folger Mobility Corridors and Terrain	1:50,000	Subset of LOC's and Streams Merged with the Cross-Country Movement Overlay and Corridors
17. Granbury Map	1:50,000	Map Coordinates and Grid Ticks, LOC's, Coded Streams, Town Boundaries
18. Granbury Soil (Wet)	1:50,000	Flood Plains Color Coded by Cross-hatching
19. Granbury Vegetation	1:50,000	5 Color Coded Overlay - Mobility as a Function of Vegetation
20. Granbury Soils	1:50,000	5 Color Coded Overlay - Mobility as a Function of Soils
21. Granbury Slope	1:50,000	5 Color Coded Overlay - Mobility as a Function of Surface Configuration
22. Granbury Cross-Country Movement	1:50,000	5 Color Coded Overlay - Product of Vegetation, Slope, Soils

Figure 7.1-12. TIAX/IPB Phase A List of Overlays

larger enemy forces as they will be generally limited to wider fronts and can be safely or rapidly moved in very constricted, difficult terrain only with unusual and time consuming efforts. The enemy forces being dealt with by friendly commanders at the echelons of regiment and battalion are the smaller elements which more readily can maneuver through the difficult terrain and obstacles. Their actions and routes are much more difficult to analyze and predict in advance of conflict; if predictable at all it will be because the friendly commander and intelligence staff have directly examined the detailed terrain, an unlikely advantage in most situations.

- The study effort to date suggests that an automated system at the higher echelons described would function effectively with terrain/weather effects data at a granularity level substantially less than that currently in preparation. The example of soils data as discussed in Section 5.2 is cited. The Ft. Belvoir soils overlay on acetate delineates 16 soil classes. If examined for effects on armored vehicle mobility it is found that the 16 classes can be grouped into at most 5. Wet weather conditions significantly affect mobility in only 2 or 3 of the soil classes. This suggests that the preparation of such data, if dominantly for application in automated IPB work, could be substantially simplified.

  This should not be construed to deny the value of the information represented by the Ft. Belvoir TAC Laboratory. Some data not required for automated overlay presentation could well have value if stored in manual files.

The analyst uses prestored overlays of gross soil classes to rapidly narrow and focus his analysis of soil/surface condition effects on mobility. The advantage of including only the right degree of granularity of data in the automated system is to keep the analyst's workload at a manageable level for functioning in a real-time environment.

- A result of the present contract effort has been to provide an initial definition of what data are militarily significant for an automated IPB system. The concept suggests that in addition to limiting granularity of terrain/weather data (as discussed in the paragraph immediately above), it should be feasible to design partial arrays of enemy forces that provide for discrimination between options without presenting the analyst with the total array of battalions and support elements that constitute a type division. The study has resulted in a definition of process flow steps and an initial structure of data base elements and displays that suggest the levels of militarily significant data.

- A result of the study is an understanding of the scope and the magnitude of the input data automation task needed to implement such a system. Proceeding from the definition of number and types of files and displays and the steps needed for their creation, it is possible to initiate the sizing of system characteristics including instruction sets, main memory and peripherals.

- The display hardware used in demonstrations in this phase was an existing facility device as described in Section 6.2. The display is a character (not pixel) addressable device. It is threfore inherently limiting when it comes to storing

and displaying terrain factor categories. For example, at a 1:50,000 scale, the basic square spot that can be individually illuminated is equal to 500 meters on a side. This means that when converting data for digital display, the manual or machine algorithm technique would at best yield the resolution of this spot dimension. A better approach to overcome this condition is selection of a true pixel device in which individual pixels are capable of being addressed and illuminated. Such devices are available with color/shading characteristics and device speeds equivalent to the character-oriented devices.

- Effort under this contract has resulted in definition of an organized and systematic approach for effective real time use of IPB techniques during conflict periods. This is felt to be a potentially powerful extension of IPB concepts which heretofore have been directed primarily at preparation before the battle.

APPENDIX A

DETAILED LIST OF

MAJOR APPLICATION DATA BASE
CATEGORIES AND MAJOR DISPLAY
CATEGORIES

MAJOR APPLICATION DATA BASE CATEGORIES

DB-A	TERRAIN/WEATHER FACTORS DATA BASE
DB-B	COMPOSITE MOBILITY FACTORS DATA BASE
DB-C	DOCTRINAL TEMPLATES DATA BASE
DB-D	SITUATION TEMPLATES DATA BASE
DB-E	EVENT TEMPLATES DATA BASE
DB-F	DECISION TEMPLATES DATA BASE
DB-G	CURRENT OPERATIONS/CONTROL PARAMETERS DATA BASE
DB-H	INPUT REPORT DATA BASE
DB-J	SITUATION DATA BASE
DB-K	TARGET AREA PLANNING SUPPORT DATA BASE
DB-L	INTELLIGENCE COLLECTION SUPPORT DATA BASE
DB-M	ENEMY INTELLIGENCE DATA BASE
DB-N	FRIENDLY FORCE DATA BASE

DB-A TERRAIN/WEATHER FACTORS DATA BASE

Map Background File

(includes primary roads, major built-up areas and major water)

Terrain Factor Overlay Files

Slope

Surface/Soil - Dry

Surface/Soil - Wet

Surface/Soil - Frozen

Vegetation - in foliage

Vegetation - without foliage

Wetlands - Dry

Wetlands - Wet

Lines of Communication

Built-up Areas

Intervisibility - Line of Sight

Intervisibility - Other

Terrain Technical Data Files

LOC Technical Data

Built-up Area Technical Data

Aerial Imagery Index to Hard Copy Photos

Weather Factors Overlay File

Weather Factor Effects on Operations

Weather Factors Technical Data File

Weather Climatological Data (Seasonal norms, ranges for 5-10 years)

Weather Degradation Factors File - For computing modifications to Surface/Soil Overlays and Wetlands Overlays as a function of near term weather forecast

DB-B COMPOSITE MOBILITY FACTORS DATA BASE

Combined Obstacles Overlay File
Modified Combined Obstacles Overlay File
Mobility Corridors Overlay File
Obstacle Plan Technical Data File

DB-C DOCTRINAL TEMPLATES DATA BASE

Unit Organizational Tables
(includes organizational structure; personnel and equipment types and strengths)

Unit Spatial Templates for each of the following:

Echelon	Type	Mission/Action
Regiment	MR Tank	Offense, Main Attack
		Offense, Secondary Attack
		Offense, Meeting Engagement
		Defense, Retrograde
		Defense, Delaying/Reinforcement
		Road March
Division	MR Tank CA	(ditto above)
Army	MR Tank CA	(ditto above)

DB-D SITUATION TEMPLATES DATA BASE

NOTE: Situation Templates break down into several subcategories enumerated below. They are unit-oriented and are modified doctrinal templates keyed to options, time sequence and area.

Options File
- Option A
- Option B
- Option C, etc.

Snapshots File
- Option A
  - Snapshot A1
  - Snapshot A2
  - Snapshot A3
- Option B
  - Snapshot B1
  - Snapshot B2, etc.
- Option C, etc.

Situation Templates (within Snapshots) File

(These are unit-oriented, showing only the key differentiators between options)

- Situation Template A11
- Situation Template A12
- Situation Template A13
- Situation Template A14

The occurrence of one or more of these will ordinarily cause the analyst to invoke the associated Event Analysis Matrix/Event Template

- Situation Template A21
- Situation Template A22
- etc.

DB-E EVENT TEMPLATES DATA BASE

NOTE: There is an Event Analysis Matrix/Event Template for each Snapshot. An Event Analysis Matrix/Event Template usually consists of multiple events (reports) which are linked over a several hours period. The multiple events are predicted to occur in sequence following the identification of a situation template match.

Event Templates File

Tabular	Graphic
Event Analysis Matrix A1	Event Template A1
Event Analysis Matrix A2	Event Template A2
Event Analysis Matrix B1	Event Template B1
etc.	

NAI/TAI Geo Definitions File

Template Planning File

Situation Template Workspace - for modification of existing Situation Templates

Event Analysis Matrix/Event Template Workspace - for creation of new (or modification of existing) Event Analysis Matrices/Event Templates to permit collection and monitoring of events not anticipated during the IPB planning cycle.

Templates Index File - List of all Templates including unit type, echelon, geo-location.

NAI/TAI Index Assignments File

List of all NAIs and TAIs in numeric order and indexed to show assignment to Event Analysis Matrices and Event Templates.

DB-F DECISION TEMPLATES DATA BASE

Decision Templates File

Snapshots from prestored snapshot file but modified to represent a predicted Enemy/Friendly disposition of forces (includes historical versions).

DB-G CURRENT OPERATIONS/CONTROL PARAMETERS DATA BASE

Friendly Commander's Mission/Plan/Target Extracts (from Op Plan and Frag)

Friendly Commander's Area of Interest/Area of Influence Assignments

System Control Parameters File (includes NAI/TAI thresholding parameters - time window and count)

Current Filter Parameters File (includes adjustable input filter parameters under control of this analyst)

Battle Dynamic Geo Definitions (includes control areas, boundaries, FEBA, etc.)

Commander's EEI and OIR Lists

DB-H INPUT REPORT DATA BASE

Input Message Queue (Unit ID, FOM or NAI message)

Input Report File

DB-J SITUATION DATA BASE

Aggregated Situation File (from G3)

(includes historical versions)

DB-K TARGET AREA PLANNING SUPPORT DATA BASE

Prestored TAI Analysis Matrices File

and

Prestored TAI Templates File

NOTE: There is a TAI (Target Area of Interest) Analysix Matrix and TAI Template for each Snapshot. These will usually define multiple target areas of interest which are linked over a several hours period. Multiple targetable events are predicted to occur in these TAIs in sequence following the identification of a situation template match.

TAI Advisory Message File

Advisory message sent by IPB analyst to FSE each time he releases a TAI Analysis Matrix/TAI Template. It describes the time window applicable and any special conditions which could impact FSE planning.

Potential Targets Data File

This is an additional file for handling ad-hoc target area of interest information which the IPB analyst elects to send to the FSE.

Enemy Weapons Emplacement Overlay File

Friendly Weapons Emplacement Overlay File

DB-L INTELLIGENCE COLLECTION SUPPORT DATA BASE

Prestored RFI Set File

These are RFI sets which were pre-planned at the same time the Situation Templates/Event Analysis Matrices/Templates were structured. The appropriate RFI set is released to the MMDS at the time the IPB analyst invokes an Event Analysis Matrix/Event Template for monitoring.

DB-M EMEMY INTELLIGENCE DATA BASE

Enemy Unit Data File (extracted from various Orders of Battle including enemy position, status, capability, etc.)

Enemy Weapons Technical Data File

Enemy C-E (Communications-Electronics) Current Assignment Data File

Equipment/Unit Correlator Data File

NOTE: The files enumerated in this category are used by the IPB analyst in the process of creating Event Analysis Matrices/ Event Templates and TAI Analysis Matrices/TAI Templates.

DB-N FRIENDLY FORCE DATA BASE

Friendly Unit Data (including current position, status, capability and planned position, status)

Friendly System Doctrinal Templates File

NOTE: The files enumerated in this category are used by the IPB analyst in the process of assembling the Decision Templates for release to the Commander.

DISPLAY CATEGORIES

D-000 Primary IPB Information Display Set

D-100 General System Control Display Set

D-200 Analyst Common Display Set

D-300 IPB Analyst Display Set

D-000 PRIMARY IPB INFORMATION DISPLAY SET

Decision Template Display

Modified Combined Obstacles Display

Mobility Corridors Display

TAI Advisory Message Display

NOTE: These displays represent the primary output product that results from the IPB analyst's effort. These displays are periodically approved and released by the analyst supervisor to the Commander and G2/G3 Staff.

D-100 GENERAL SYSTEM CONTROL DISPLAY SET

Dynamic Purge Control

Purge controls used by analyst supervisor to change the criteria the system has for automatic purging of IPB stored data.

Analyst Area Assignment Control

Used by supervisor to adjust boundaries between individual analyst geo-areas.

Filter Parameter Selection Control

Used by individual analysts to change system filter parameters on input report processing.

NAI/TAI Definition Control

Used by individual analysts to create or modify NAI/TAI control parameters (time window, count of reports and/or objects) he wants automatically monitored.

Template Build/Modification Control

Weather Effects Computation Parameters Control

Used by analyst to set parameters for system computation of weather effects on terrain.

D-200 ANALYST COMMON DISPLAY SET

IPB Display Glossary

RFI Preparation Formats

Input Message Queue

Prestored Query Menu

Prestored (Modifiable) Query Formats

Prestored Query Response Queue

NOTE: The prestored query formats provide the means for accessing/querying a number of general data bases (see lists DB-G, DB-L, DB-M and DB-N) to retrieve/display information such as:

Battle Dynamic Geo-Definitions
Commander's EEI and OIR lists
Enemy Order of Battle data
Enemy C-E Current Assignments
Planned Friendly Unit Situation
etc.

D-300 IPB ANALYST DISPLAY SET

Map Background Display

Terrain Factor Overlay Displays (per DB-A list)

Terrain Factor Tech Data Displays (per DB-A list)

Weather Factor Overlay Display

Weather Factor Tech Data Display

Combined Obstacles Display

Obstacles Plan Tech Data Display

Modified Combined Obstacles Display (repeated from D-000)

Mobility Corridors Display (repeated from D-000)

Prestored Templates Menu
(Includes Doctrinal, Situation and Event Analysis Matrix/Event Template categories)

Prestored Doctrinal Template Displays (per DB-C list)

Prestored Situation Template Displays (per DB-D list)

Prestored Event Template Displays (per DB-E list)

Prestored Event Analysis Matrix Displays (per DB-E list)

NAI/TAI Geo-Definitions Display
This is a tabular listing. The NAI/TAI geo-locations appear on the Event Templates.

Event Analysis Matrix Build Format
Used by analyst to construct new matrices.

D-300 (continued)

Templates Index Display

Used by analyst to retrieve individual prestored templates. Lists unit type, echelon, geo-location.

NAI/TAI Assignments Index Display

Lists all NAI/TAI's numerically and provides index to show assignment to Event Analysis Matrices/Event Templates.

NAI/TAI Area Summary Display

Provides the analyst with a status summary of all NAI/TAI areas within an option that the system is currently monitoring.

Event Analysis Matrices Summary Display

Provides the analyst with a status summary of all Event Analysis Matrices within an option that the system is currently monitoring.

Decision Template Displays (repeated from D-000)

Includes history file of released Decision Templates.

Input Report Display

Aggregate Situation Display

This display is generated external to the IPB analyst function. It is used by the IPB analyst primarily to construct Decision Templates and to construct new and modified Event Analysis Matrices/Event Templates.

D-300 (continued)

Area Situation Display (Subset of Aggregate)

TAI Advisory Message Display (repeated from D-000)

TAI Analysis Matrix Display

TAI Template Display

The above two TAI related displays are forwarded with the TAI Advisory Message to the FSE.

Potential Targets Data Display

This display provides type and geo-location of additional potential targets identified by the IPB analyst and not contained in the prestored TAI files.

Enemy Weapons Emplacement Overlay Display

Friendly Weapons Emplacement Overlay Display

The above two weapons emplacement displays represent the IPB analyst's evaluation of optimum-likely weapon emplacements as a function of terrain, weather, intervisibility and anticipated maneuver tactics. These are forwarded to the FSE.

Prestored RFI Set Menu

Prestored RFI Set Display

RFI Sets are generated at the time the Event Analysis Matrices/Event Templates are created and are prestored. The RFI Sets are used to communicate sensor collection tasking requests/priorities to the MMDS.